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ABSTRACT

This book offers a systematic examination of how teachers react--and how teaching and learning change--when computers come into the classroom. It describes a longitudinal study which took place in 13 elementary schools (8 public, 3 parochial, and 2 private) in Kentucky. Through a variety of data collection methods, the study explored and documented questions, issues, and experiences surrounding the dynamics of technical change involving computers in elementary schools. The best and worst ways to use computers in the classroom are explored and strategies are provided for using computers effectively to enhance teaching abilities. The chapters are: (1) Computing and Teaching in Elementary Schools; (2) Introducing Computers in Schools; (3) Motivating Teachers To Change; (4) Computing Styles Among Teachers; (5) Considering the Effects of Computing on Teaching; (6) Shifting Responsibilities: Computer Coordinators in Schools; (7) Computing and Occupational Rewards for Educators; and (8) Guiding Schools through Computer Integration. The research methodology is described in an appendix. (Contains 96 references.) (AEF)

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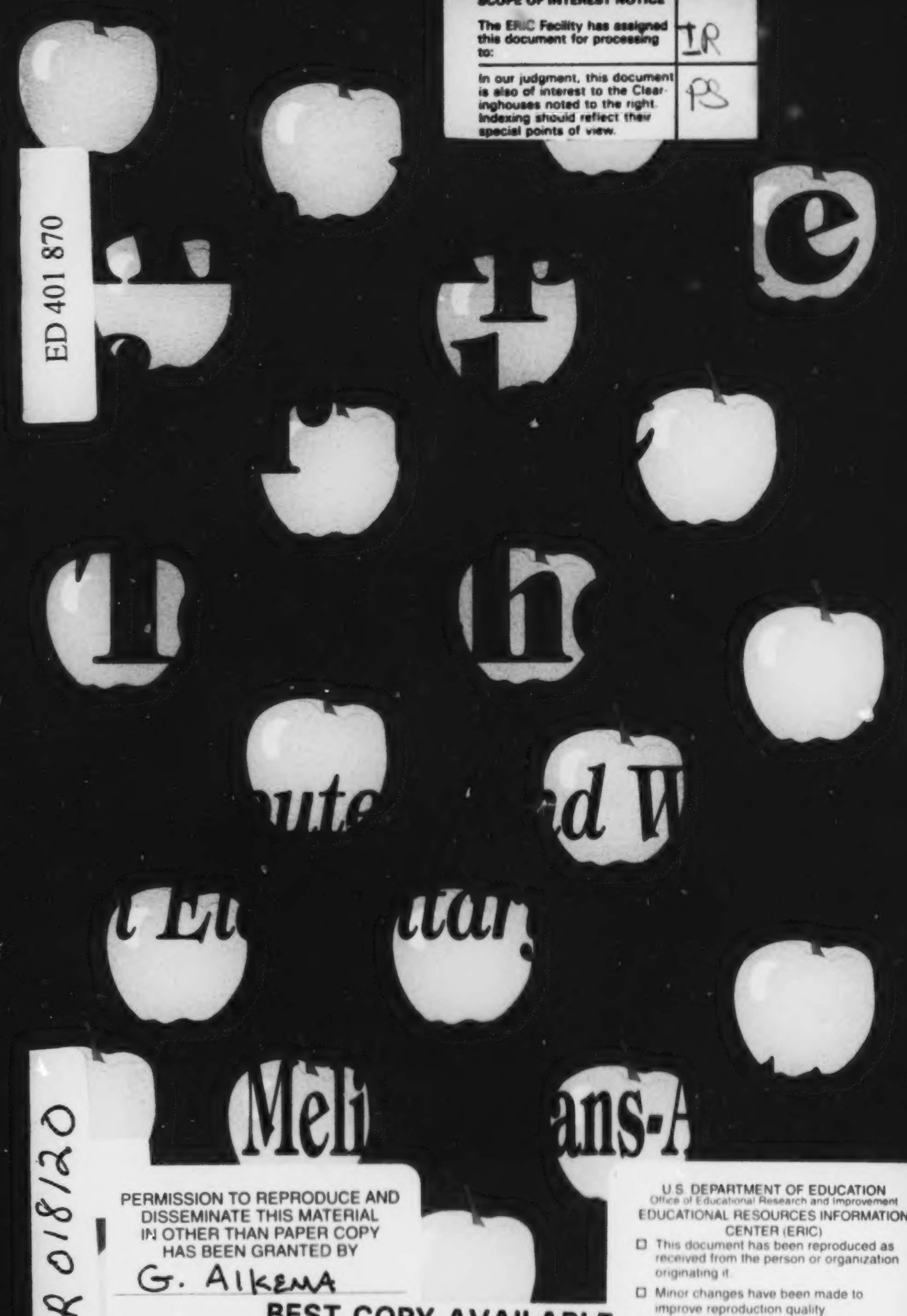

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An Apple for the Teacher

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Computers and Work in Elementary Schools

Melissa Evans-Andris

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Preface

My observation of computer implementation began in the mid-1960s while I was in high school. At that time, much to my math teacher's delight, the school acquired its first computer. The machine was linked by modem to a mainframe computer located elsewhere and operated from a teletype machine using punch paper tapes. For lack of space in the school and also for security reasons, the computer was housed, along with janitorial supplies, in a broom closet located across from our math classroom. My class learned how to program the computer using BASIC and we spent many hours over the course of a semester programming math assignments and games such as blackjack in our classroom and running across the hall to the closet to punch the tape and run the program.

Nearly 10 years later, as a teacher myself, I watched another high school acquire and implement a computer. Some of the aspects in that school were similar to my earlier experiences. For example, the one computer, a WANG, was sequestered by the math department and again, for lack of a better location, it was placed in a broom closet. Beyond that, however, I was never quite certain how the computer was used or the effects that it may have had because I did not teach math and the closet was not anywhere near my own classroom.

In the mid-1980s, approximately 20 years after my first computing experiences, I had a third opportunity to watch the computer implementation process firsthand. This time the setting was my children's elementary school and the equipment was Apple II personal computers. Over the course of two decades, computers had made their way from broom closets containing one machine at a time to classrooms that had been converted to computer labs large enough to hold enough computers for an entire class to use simultaneously. These personal computers ran from preprogrammed disks so, rather than teaching students to program the computers, the children used software designed predominantly for fact reinforcement and playing "the games."

Though there were differences in the ways that personal computers were introduced and intended to be used in the elementary school, other aspects of the implementation process were similar to my earlier observations and recollections. For instance, the school looked to teachers with strong math skills for computer guidance and assistance, even though there was no evidence to suggest that those teachers knew any more about the process of computing than anyone else in the school. As when computers had been located in broom closets, no one in the school other than the math teachers seemed to know too much about what was going on in the computer lab, nor did they seem to care.

As I watched my children's school implement computers, schools, along with other places of work nationwide, began acquiring personal computers in record numbers. This movement sparked my curiosity. How is computer technology best introduced? How do workers use it? What happens to jobs and work skills when computers are introduced? I explored literature regarding innovation with advanced technology, workplace cultures, and the organizational context of schools in my pursuit of answers to these questions. The issues raised in this literature encouraged me to consider what was happening to teachers in my children's school as they learned to use computers and begin to place those experiences in a broader context by comparing them to those of workers in other organizational settings.

Research Setting and Method

This study is the product of a systematic examination of the questions, issues, and experiences surrounding the dynamics of technical change with computers in elementary schools. The study took place in 13 elementary schools (8 public, 3 parochial, and 2 private) located in one county of a metropolitan area of nearly 1 million people in Kentucky. Six of the schools were situated within city limits and the others in various suburban areas. The schools were similar in size, each enrolling between 350 to 400 students and employing 20 to 26 teachers. Class sizes in the schools ranged from 15 to 32 students, with the larger classes found in the public schools.

I collected data for the study in two phases as part of a longitudinal project. The first phase was conducted at least 4 years after each of the schools acquired computers for the first time. The second phase was conducted 4 years after the first, so that each of the participating schools had computers for at least 8 years. In the more recent phase, new schools were added to the original sites in instances in which respondents from the first phase had changed schools since that time. Each school centralized its computing resources in computer labs and, whereas 2 of the schools had brand new equipment at the time of the second phase, the other 11 schools were still using their original computing equipment.

Between the first and second phases of the study, the Kentucky General Assembly passed the Kentucky Education Reform Act (KERA), an extensive and comprehensive plan for school reform addressing three major areas of schooling—including finance, governance, and curriculum. KERA has an educational technology component mandating increased implementation of computers in schools to improve (a) student learning and performance, (b) teaching and teaching performance, and (c) the efficiency and productivity of administrators.

In the first phase of the study, I employed ethnographic methods including observation and interviewing, and then replicated those methods in the second phase. I observed teachers and other participants while they were in the computer labs of their schools with students. I also observed and casually talked with participants in their classrooms, offices, teacher lounges, cafeterias and hallways, as well as during formal and informal computer-related training sessions. Over the course of both phases of the study, I spent several hundred hours engaged in observation, focusing particularly on the interaction patterns between coordinators, classroom teachers, students, and administrators with regard to computer activities in labs and classrooms. These observations of educators in their natural work setting facilitated my assessment of their workplace climates and working relationship with their colleagues, as well as their management and control of computer equipment and general attitudes of participants toward computer applications in schools. Likewise, the sessions often provided a starting point for subsequent in-depth interviews.

Forty-five respondents participated in formal interviews during the first phase of the study. For the most part this same panel of respondents participated in the second phase. The general format of the interviews employed funneling techniques (Gordon, 1980) to acquire general and then more specific information regarding professional responsibilities, routines, and patterns. In addition to the principal, I also interviewed the computer coordinator as well as several teachers in each school. All of the interviews took place in the schools and were held in offices, classrooms, lounges, or in the computer labs. These locations were convenient for the respondents and also allowed me to gain information about their working patterns while actually in their natural work setting. The ethnographic methods employed in this study and collection of multiple accounts generally enhanced my appreciation of what actually occurred and provided a means to generate analytic categories and explore the complex relationships in the data. An appendix providing a more detailed account of the methods used in this study is found at the end of the book.

Acknowledgments

I would like to express gratitude to many people for their help in my completion of this project. I thank my faculty advisors from Indiana University, particularly Randy Hodson, Maurice Garnier, Suzanne Staggenborg, and Eugene McGregor for providing guidance and enthusiastically supporting my ideas regarding the study on which this book was based. I thank Brian Powell for his insight, moral support, and encouragement throughout the study, particularly during the final stages of completion. I am grateful to each of these individuals, along with my colleagues at the University of Louisville, especially Cynthia Negrey, Allen Whitt, Tom Keil, and Wayne Usui for their helpful comments and suggestions. My appreciation also goes to Alice Foster from Corwin Press for her editorial instruction.

It would not have been possible to pursue this project had it not been for the cooperation and contributions of educators in the local public, private, and parochial schools that participated in this study. For allowing me entrée to their schools and classrooms and for their willingness to share time, honesty, and critical insight during the study, I am grateful to the faculties and administrators of these schools. I also thank individuals from the computer implementation unit at the local board of education and key educators from the state department of education for their helpful comments and enthusiasm for this work.

I am indebted to the Spencer Foundation, the American Sociological Association, and the University of Louisville for their financial assistance through research grants that supported the second phase of this study. The data presented, the statements made, and the views expressed are solely the responsibility of the author. Earlier versions of portions of this book have appeared in the following journals. "An Examination of Computing Styles Among Teachers in Elementary Schools" appeared in *Educational Technology Research and Development, 42*(2), 15-32, and "Barrier to Computer Integration: Micro Interaction Between Computer Coordinators and Classroom Teachers in Elementary Schools" appeared in the *Journal of Research on Computing in Education, 28*(1), 29-45.

I extend a world of gratitude to my family. I thank my mother for her understanding and encouragement and my father for sharing his insight and experiences regarding the world of computers with me. I love and thank my husband, John, and my children, Janey and Johnny, for their endurance, patience, and pride in my work.

About the Author

Melissa Evans-Andris is Assistant Professor of Sociology at the University of Louisville, Kentucky. She received her Ph.D. in Sociology at Indiana University in 1991. Her research interests are in the sociology of education, occupations, and work. Her research has focused on occupational dynamics among teachers on the introduction of new instructional technologies to their workplace. She continues to follow the ongoing process of computer implementation in local schools longitudinally. She has also expanded the research to examine computer implementation in rural school districts. She is active in local and state-wide activities related to the Kentucky Education Reform Act.

1

Computing and Teaching in Elementary Schools

The introduction of computer technology has spread rapidly throughout the field of education over the last decade. Spurred by efforts to improve learning, productivity, and competitiveness (Rumberger, 1984), the number of computers in schools increased dramatically. Whereas only 15% of elementary schools touted computers in the early 1980s, this number soared to more than 95% by 1990 (Becker, 1993), and the density of computers in schools has continued to increase since that time. The widespread implementation of computers in elementary schools has been accompanied by a proliferation of software intended to complement regular instruction and also to be used for enrichment, remediation, and tutorial purposes. The software designed for elementary school application ranges from drill and practice and keyboarding to graphics and publishing. More recently, we have also seen the development and availability of even more sophisticated technologies, such as compact discs and CD-ROMs, and others involving electronic communications, such as e-mail.

Though increasingly more affordable, the introduction of instructional technology in schools represents a substantial capital expenditure. For example, the board of education in the county where this study was conducted spent more than $9 million over 6 years in efforts to install and implement computers countywide. The initial outlay of money is only the beginning, though, due to the ongoing development of more powerful machines. Schools struggle to stay abreast of rapidly changing technology in their attempt to acquire and then replace first generation computers with newer, more sophisticated equipment. The expense of purchasing, maintaining, and updating computing equipment and training teachers to use it presents a staggering financial burden for school districts.

Despite the expense that instructional technologies represent, educational reform efforts nationwide have directed attention to the advancement of computer technology for schools. As one account recently claimed, "Support for the use of technology to promote fundamental school reform appears to be reaching a new high" (Jones, Valdez, Nowakowski, & Rasmussen, 1995, p. 1). Indeed, in Kentucky, the setting for this study, the Kentucky Education Reform Act (KERA) was passed in 1990, mandating, among other things, the acquisition and use of instructional technology, particularly computers, for schools at all levels.

As technology and its capabilities have changed and expanded over the last decade, corresponding educational objectives involving computer applications, too, have shifted. Whereas programming, using computer languages such as BASIC, may have been the focus of computing instruction until the early 1980s, when companies began vending microcomputers to schools, computers came into their own with software designed for computer-assisted instruction, particularly drill and practice and word processing. Toward the end of that decade, the focus changed again, to the use of the computer as an integrative tool for learning. Presently, an extension of that objective encourages the use of new technology to stimulate active, engaged learning (Becker, 1993; Jones et al., 1995; Reinen & Plomp, 1993).

Even though computing may facilitate integrated, active learning, this remains elusive. Consistently, studies of computing in elementary schools reveal that teachers apply computers in ways demonstrating low levels of integration and favoring drill-and-practice routines (Becker, 1991; Reinen & Plomp, 1993).

Other studies report that teacher-use patterns focus on resistance or avoidance, thus leaving computing activities to a relatively small portion of teachers among school faculties (Evans-Andris, 1991; Reinen & Plomp, 1993). This research suggests that even though the presence of computers may be commonplace, they may have achieved merely a token status in elementary schools.

Despite the broadscale implementation of computers in schools, little is known about this process or the ways that teachers have responded to this change. We know that the effects of computing can be far reaching, but lack of understanding of the relationship between technological change and the occupational dynamics within schools leaves us with many unanswered questions. How have teachers incorporated computers into their work patterns? Have computers disrupted the traditional skills of teachers? What are the consequences of this technological change for the occupational culture of educators? I address these and other related questions in this study.

Theoretical Background

Three literatures including the sociologies of organizations, work and occupations, and education provide a framework for the examination of computer implementation in schools. Organizational literature, particularly that pertaining to innovation, argues that technical change is best understood when viewed as a process occurring over time (Brewer & DeLeon, 1983; Hall & Hord, 1987), and it is most likely to succeed when it is carefully planned, introduced, managed, and otherwise supported organizationally. Studies from this perspective identify various structural factors within organizations, such as goal setting, managerial arrangements, staff development, and incentive programs that facilitate the process of change.

Second, the literature on work and occupations contributes to our understanding of technological change in the workplace by shifting the focus to the occupational culture of the worker. New technology disrupts occupational skills, roles, norms, and other cultural features of work, although the direction of change is a topic of much debate. The literature traditionally described technological change as an instrument of control used by management in the struggle for power over the labor process and argued that jobs, worker skills, and other aspects of work became degraded in the process of change (Braverman, 1974; Cornfield, 1987; Edwards, 1979). In contrast, perspectives advocating technical change typically argue that new technology enhances the workplace and the role of the worker by upgrading skills, expanding opportunities for occupational rewards, and generally improving the conditions of work (Adler, 1986; Attewell, 1987). Both sides of this debate conceptualize worker behavior in the process of change either as relatively passive or as a constrained response to management, ranging from compliance to resistance (Hodson, 1991a). Both also imply that change is uniform across occupations.

More recently, studies in the occupational literature promote the consideration of worker autonomy in the process of change (Barley, 1988; Brown, 1981; Finlay, 1988; Hodson, 1991; Lipsky, 1980). These studies examine the contributions that workers make in shaping the use of new technology in their workplace and promote a model of technological change and work that, in addition to other organizational and occupational factors, includes workplace autonomy as an important aspect in the process of change.

The organizational and occupational literatures together suggest that it would not be unlikely to find heterogeneous impacts of new technology on work, depending on how organizations implement change and how workers use it. The degree to which workers can act autonomously, however, may be determined by the organizational context in which they work. To more fully understand technological change in schools, it is necessary to consider contextual elements distinctive to the educational setting.

The sociology of education facilitates our understanding of the process of technical change in schools by directing attention to organizational features unique to schools as well as occupational characteristics of teaching that may explain the nature of change in schools and teachers' response to it. For example, the research often argues that schools function as institutional organizations (Hannaway, 1993; Meyer & Rowan, 1977) and commonly describes the administrative arrangement within schools as "loosely coupled" to explain the levels of administration supervision, autonomy of teachers, accountability, and performance. These features may contribute to the relative stability of teaching routines in the face of technical change (Bidwell, 1965; Cohen, 1987; Hanson, 1981; Lortie, 1975; Tyler, 1985).

My review of the research suggests that no one framework alone adequately explains the experiences of teachers when computers are introduced to their working environment. In combination, however, the sociological literatures on organizations, work and occupations, and education provide the most useful theoretical base from which to address the issues and this study draws on all three.

Implications

The introduction of computers in schools raises the question that experimentation with a new technology through "trial and error" may be a necessary part of the learning process, both for schools and for educators. With regard to the use of computers in schools, Becker (1993) suggests that "inefficiency may simply be a necessary pre-condition for subsequent effective use" (p. 128). I disagree with this position. Although directed experimentation is beneficial to develop or refine computing strategies, haphazard experimentation with new technology through trial and error is costly in money and time, both of which are scarce resources in schools. In addition, aimless experimentation stifles the eager, willing attitude among users and replaces it with frustration and hesitation.

The purpose of this book is twofold then. First, I develop a comprehensive theoretical explanation of technological innovation and teaching that considers both organizational and occupational factors in the process of change. An examination of the implementation process in combination with the assessment of the experiences of teachers on the introduction of computers in elementary schools provides a better understanding of the effects of that technology on the school environment as well as on the participants and processes in schools. Second, drawing from the experiences of teachers, I develop a practical guide for schools to use as they implement new computer technology. From that, educators may be encouraged to develop more strategic policies of computer implementation and management that will optimize the resources available to the school and optimize the effects of computers in schools and on the jobs of teachers.

Organization of the Book

The remainder of this book considers the organizational factors that shaped the computer implementation process in local elementary schools and then considers the effects of that process on the occupational dynamics among teachers. In Chapter 2, I examine the organizational context within which computer innovation occurred. This chapter traces the process of implementation beginning with the flow of technical change, the goals guiding change, and the management of change in schools. It also explores in detail the issue of staff development. It reveals that the process of computer implementation in local schools began rather passively and continued in an unsystematic fashion. Problems emerged in the process, and, whereas schools have addressed some of these problems in more recent years, others still persist.

In Chapter 3, I continue the examination of organizational context by identifying and discussing the elements within the school environment that encourage or dissuade teachers from using computers. I present evidence that demonstrates that, lacking formal organizational incentives to change from within their schools, most teachers derived motivation to use computers from informal sources within their schools and school communities. These informal factors of motivation helped sustain the loosely coupled arrangement characterizing the relationship between administrators and faculties of schools, and heightened the discretion and autonomy of teachers in the implementation process.

Chapter 4 considers teachers' responses to computer implementation and contends that teachers exercised their autonomy in the process of change by developing strategies of computer implementation. Through these strategies, teachers developed and sustained three styles of computing ranging from a style of avoidance to styles of integration and technical specialization. These styles of computing enabled teachers to meet organizational expectations regarding their computing behavior and also satisfy their own workplace interests and concerns pertaining to computing.

Beginning with Chapter 5, I examine the effects of computers on the traditional occupational features of teaching. In this chapter, I argue that although technology disrupts the work of teachers—the effects of which are often expressed by teachers' concerns—the direction of disruption and related concerns may be contingent on the styles of computing that teachers pursue. This suggests that unlike settings where worker autonomy is reduced, in the classroom, teachers are instrumental in determining how computers affect them and their jobs.

In addition to affecting worker skills, the presence of computers created new roles and opportunities involving occupational gains for educators. Chapter 6 examines the role of the computer coordinator, a relatively new and largely undefined position that emerged in schools during the process of computer implementation. As a position of leadership, the computer coordinator potentially is quite powerful and influential. I argue, however, that microprocesses of interaction between coordinators and other educators in schools reduced the effectiveness of individuals in this position. In addition to creating positions of computer coordination, computing expanded opportunities for educators to gain other occupational rewards in elementary schools. Chapter 7 examines gains realized by teachers who promoted computing in their schools by demonstrating enthusiasm, engaging in leadership activities, and subscribing to stronger styles of computing, such as integration or technical specialization.

Finally, Chapter 8 concludes with a discussion of the implications of the findings from this study for a model of technical change and teaching. I also offer recommendations for policymakers and other educators involved with the computer implementation process in hopes of guiding them in their attempts to develop more effective, integrative computer programs for their elementary schools.

2

Introducing Computers in Schools

The crowd at the Chamber of Commerce-sponsored city meeting was listening intently. The keynote speaker, a prominent consultant from an elite eastern technological institute, had just been challenged from the floor. A leader in the local business community questioned him, "If you had two million dollars to spend, what would you do for our city?" The speaker responded that, in his opinion, computers in schools should be a top priority in any community. The audience was temporarily silenced when, without hesitation, the local business leader turned and calmly stated, "You've got it."

In that instant, without warning, a massive countywide school system was hurled on the road to educational change with computer technology.

The 1980s, generally, were a time when educational effectiveness was challenged nationally. Many reports implied that the nation's declining economic position was in large part due to the stagnancy within the educational system (Sims, 1984). Frequently, schools were criticized for their inability to provide sufficiently responsive and appropriate services to students. Often, they were plagued by fiscal crises because the need for services and current educational equipment exceeded the resources available. Critics charged schools with a failure to adapt to demands of technological change in the broader society.

During this time, computer companies began targeting schools as potential markets for their products. They presented advertisements such as, "Learn everything from language, to chess, to touch typing all at your own pace from a teacher that never gets tired or impatient. Learning has never been more fun!" (Hawkridge, 1983). Apple, then one of the largest computer suppliers for schools, claimed that an Apple "helps to increase student motivation and improve knowledge retention" (Hawkridge, 1983). Prompted by the impression that computers would better prepare young people for a high-tech world and, in turn, promote a stronger economy for the future, business leaders and parent-teacher associations throughout communities met and decided individually that their schools should innovate with computers.

Spurred by efforts to improve learning, productivity, and competitiveness, the number of computers in American schools increased dramatically from the early 1980s to the present. In many instances, however, decision makers advanced plans for computer innovation without attending specifically to the ways in which the computers would be introduced, used, or evaluated at the school level. Successful strategies of implementation or execution of an innovation are critical to its effectiveness (Joshi, 1991; Kraemer & King, 1986), yet these are factors that all too frequently are overlooked in the process of change (Brewer & DeLeon, 1983). Although most schools acquired computers over the last decade, the focus seemed to be on acquisition as opposed to effective implementation.

This chapter discusses the experiences of elementary schools in the local community on the introduction of computers. It examines features of the implementation process, giving particular emphasis to the flow of technical change within the schools, the goals guiding the process, and the ways that computer implementation was managed in schools and supported through staff development. The flow of change, clarity of goals, management of change, and staff development, as well as the social context in which change occurs can affect the success of technological innovation. Each of these features of implementation is discussed in the following sections.

Flow of Technical Change in Schools

Technical change tends to be most successful when it flows in a bottom-up direction within an organization, that is, when the notion of change originates among the staff itself and then disperses to various levels of management. The staff is nearest to the work core and thus in a position to readily perceive performance gaps or other activity needs. In a study of innovation in Chicago area public schools, Daft and Becker (1978) found that various technological changes, particularly those relating to the task scope of schools, seemed to flow upward from teachers to administrators. Teachers tended to be most aware of educational problems, as well as innovative solutions, and they often suggested technical changes that addressed those problems. Not surprisingly, the upward flow of proposed change from faculty to administration was associated most frequently with the successful adoption of technical change within the school.

The idea for innovation with computers among schools in the local community, for the most part, originated outside schools altogether and then flowed in a top-down direction within them. As the episode in the beginning of this chapter indicated, the initial thrust for countywide computer acquisition in the public system came from unsolicited money donated by the local business community. On receiving the money, the school district devised a plan whereby each school's local community was asked to raise 20% of the funds necessary for computer installation. That money was matched by the school district, and the remaining 60% came from grants and corporate donations. Over the course of several years, public elementary schools countywide acquired a requisite amount of money to install computers in their buildings. The flow of technical change in private and parochial schools was similar to the public system. Although these schools did not benefit from any one large lump sum grant, they acquired computers with monies raised outside the school by PTAs, individual donations, and corporate grants.

Because the idea for computer implementation in the local community, as well as its requisite financial commitment, originated outside the schools themselves, it is useful to consider what subsequent influence this flow of change might have had for the process of innovation. Were school participants less likely to embrace the technology because it was introduced from the outside? Were schools less prepared to become actively involved in the computer implementation process?

Individuals with whom I spoke recollected that initially, as computers began to be placed in schools, faculties tended to be apprehensive but enthusiastic. Teachers told me they were impressed that their local school communities would put forth such an enormous financial and otherwise active commitment to local schools. They were also impressed that parents displayed interest and concern with a school-related issue. Often, teachers remembered feeling quite excited for their students. One teacher in a public school remarked, "The kids were so thrilled they would get a chance to use computers that naturally that feeling was contagious."

When teachers began to realize that for their students to enjoy computers, they too would have to learn to use the machines, an entirely different attitude pervaded the schools. One fifth-grade teacher in a public school described the atmosphere in the following manner:

> The majority of teachers at that time didn't know why they had computers and couldn't have cared less about learning to use them. It was just "Oh dear, am I going to have to learn how to do this?" They had a real fear of the machines. Most of the teachers wanted the kids to be able to sit down and have fun with the games but not to have to get involved themselves.

Despite attitudes such as this, individuals told me that although teachers hesitated to use the equipment, there seemed to be minimal objection to its presence in their schools.

Unlike the pattern of successful innovation found by Daft and Becker (1978), whereby teachers sought technical changes to remedy specific work-related problems, computers were placed in local schools independently of the awareness among teachers of such task-related problems. The supply of computers prior to its demand by teachers generated anxiety, feelings of incumbrance, and hesitation among teachers. It seemed certain that unless clear goals, reinforced by a strong program of management and staff development, established the relevancy of the technology to curricular goals and teaching tasks, the initial pattern of skepticism would persist among teachers.

Goals of Innovation

The presence of strategic goals are an integral part of successful organizations. Functioning as indicators or targets, goals provide organizations a sense of direction toward which they may move. Goals have beneficial effects on task performance and can lead to higher levels of commitment and achievement among workers (Wagner & Hollenbeck, 1995). Successful implementation of a technical change, then, will benefit from goals that are clear, easily identifiable, and readily operationalizable (Brewer & DeLeon, 1983).

Despite the contribution that formal goals may make in the process of technical change, the goals of public service organizations, including schools, frequently are absent, ambiguous, or conflicting (Bidwell, 1965; Lipsky, 1980; Perrow, 1979; Tyler, 1985). In the mid-1980s, when schools nationally were beginning to innovate with computers, schools in the local community lacked formal goals pertaining to computer implementation. Instead, innovation was driven by informal concerns such as computer acquisition and the demonstration of computer use.

Computer Acquisition

Those schools boasting computers in the early years of computer implementation enjoyed an innovative status and cut an impressive image of competitiveness, achievement, and excellence. One principal admitted that he wanted his school to acquire computers not because of their actual effects on educational achievement but because they satisfied the local school community that his school was capable of competing with the larger schools of higher academic status in the county. He explained,

> I think there is an impression in this city that schools in the south end of town aren't competitive and can't compare to east end schools. I feel that adding computers in this school is one good way to show that we are addressing the issue of competition.

As schools acquired large quantities of computers, the decision was made to group them into computer labs. Computer labs are an efficient arrangement within schools because they can service a larger number of students at one time. On the other hand, when computers are dispersed throughout a school and located in individual classrooms, there may be greater potential that they will become an ongoing part of the learning experience. Opting for efficiency, each public elementary school installed a lab complete with 32 Apple IIe computers that were networked with a Corvus dedicated server. As with the public schools, the private and parochial schools also tended to purchase Apple IIe's and group them in computer labs. Instead of using a dedicated server, however, users generally accessed software with floppy disks. At the time that local elementary schools were installing computer labs, just over half of elementary schools nationally grouped their computers into labs. Approximately three fourths of all computers in those schools were Apple II's and fewer than 10% of elementary schools hardwired their computers into a networked system (Becker, 1991).

Perhaps to bolster a prestigious innovative image that computing equipment helped to project, many schools demonstrated that they had computer labs in highly visible ways. For example, a few schools located computer labs in rooms close to the entrance of their buildings. Nearly all the schools displayed computer-generated products, such as banners of welcome, in the entrance halls to impress visitors when they entered the building.

Even now, schools continue to rely on computers and labs as a selling point. Although one school administrator argued that, in his opinion, the issue of computers is not as "hot" as it was several years ago, others disagreed. A teacher in one parochial school explained, "The computer lab is one thing that parents are interested in, and the principal always takes new students and their parents over there to show off our lab." A computer enthusiast in a public school said that her principal asked her to plan and present special computer demonstrations during "open house nights." In another school, the principal wanted her staff to display computer-generated projects at all times. A teacher in that school commented, "Our principal looks to see results and she wants them to be visible to the parents. She wants something that they can actually see or touch. I don't know whether she wants us to demonstrate that we are responsible or credible."

Schools continue to focus much of their attention and effort on acquisition of computing equipment. Recently, as I revisited schools, nearly every teacher and principal I spoke with revealed a "wish list" that inevitably included new computers for their labs or classrooms or other equipment, such as laptop computers. On occasion, a teacher might go beyond the usual request for computers and suggest more sophisticated specialty items, such as CD-ROMs, videos, or networking capabilities.

Teachers and principals commonly requested additional equipment without providing any rationale. One first-grade teacher admitted that whereas teachers in her school seemed eager to get computers for their classroom few had any ideas or plans regarding their application. She said, "It's more that teachers are enamored with the idea of having computers than with using them." The principal in another school looked at me quizzically when I asked her why she wanted four computers in each classroom in addition to the computer lab that her school already had. She explained, "I'd like to have computers grouped into learning centers but really, if possible, my ultimate goal is to see everybody have a computer." When pushed to justify such an ambitious request she continued, "I don't know what teachers and students would use them for. Whatever they want, I guess."

Computer Use

Beyond computer acquisition, any goal associated with the computing within schools usually focused on quantitative use of the equipment rather than qualitative strategies of implementation. One public school principal succinctly described the situation in the following manner:

> They want computer literate children and we've got a lab sitting there that costs $50,000. At that price, who can afford to ask why it is here or how to use it? The cost of the lab alone mandates that it be used. People have the option to go more often and to use it any way they see fit, but they don't have the option not to go.

This administrator's main concern was simply that the computers be used. Even faculty training sessions I attended seemed to concentrate more on increasing computer use among teachers rather than on optimizing strategies of use.

Other than informal, implicit concerns regarding computer use, most schools lacked any formal policies relating to computer use in the early years of implementation. A fourth-grade public school teacher admitted that

> There's not an effort at this school to provide a computer "program," or even guidance about using the computer. We've all taken basic training here but mostly we're ignorant as to all the things that we could be doing with our computing equipment.

Even now, most teachers remain unaware of any particular policy regarding computer use in their schools. When recently asked about her school's computer policy, a computer specialist in a parochial school replied in the following manner:

> To my knowledge there isn't even any policy or explicit expectation for computer use in the Catholic school office let alone in this school. One of our big complaints is that

> we don't really know what we're supposed to be teaching or doing. There's a lot of different ideas out there. I couldn't tell you what's going on in other labs in comparison to what goes on in ours. The school office can't decide what we are supposed to be doing, and I don't think it really cares whether we exist or don't exist.

Though the parochial and private schools continue to lack explicit implementational goals, one component of the Kentucky Education Reform Act (KERA) pertaining to instructional technology has formalized goals relating to the use of computers in public schools statewide. Kentucky Revised Statutes (KRS) 156.670 specifies that technological applications should address various school-related concerns, including the improvement of student achievement, curriculum delivery, and professional development. Nevertheless, at the time of the second phase of this study, local schools had been slow to translate these global goals into operational objectives and guidelines. Perhaps because most elementary schools in the local community had acquired computers several years prior to KERA, specifications such as those contained in KRS 156.670 did not appear to have a noticeable impact in establishing goals or policies that would guide computer use in the schools participating in this study at the time of the second phase.

One way that the public schools did seem to make gains, however, was by formulating and submitting technology plans to the county school system's *computer support unit* on an annual basis, describing what technology the school had, explaining how it was used, and justifying requests for additional equipment. Those plans were, in turn, compiled into a school district plan and submitted to the Kentucky State Department of Education to be used for planning and funding purposes. Even so, it was difficult from these written statements to distinguish how and the extent to which computers were actually used versus the ways that the authors of the plans envisioned that they be used. The absence of explicit policies to guide computer implementation in local schools is characteristic of elementary schools worldwide. Only 28% of the elementary schools participating in an international survey reported having some sort of written policy regarding computer use (Wolf, 1993).

In his analysis of innovation, Drucker (1985) notes that public service organizations, including schools, commonly focus on strategies of maximization rather than optimization. These organizations are not for profit and typically derive their budgets from outside sources rather than from productive activities. This reduces the need for efficiency but increases the organization's dependency on expansion. By creating or enlarging a program, the organization's budget increases and thereby reinforces its survival chances. Computer acquisition increased school budgets and possibly for that reason, schools were apt to focus on efforts of maximization rather than optimization.

Another explanation for schools focusing on the procurement of computer equipment and maximization of its use may be that local schools hoped to derive credibility and legitimacy within the community, thus reinforcing their status and security through technical change. Schools, not unlike other service organizations, function as institutional organizations (DiMaggio & Powell, 1983; Hannaway, 1993; Meyer & Rowan, 1977), and as such, they are continually in need of legitimacy and credibility within the community. They must generate as well as sustain legitimation to survive, and to do so, they must function rationally. A gap may exist, however, between what is rational, efficient behavior for a school in actuality and what is perceived to be rational within the school community. Meyer and Rowan (1977) suggest that perceptions and rules defining rationality become institutionalized within the community and may serve as influential, motivational mechanisms for an organization in its pursuit of legitimacy. If an organization rejects or resists socially constructed beliefs and expectations regarding its mission or its operation, it jeopardizes its chances of survival or success. Instead, it must consider both rational goals as well as those that, rational or not, the community imposes. Clearly, then, because of its high visibility, appearances and perceptions of a school within the public arena are important, and maintaining them will be central to what becomes defined as school effectiveness.

Management of Change

Innovation involving technical change such as computing has the greatest likelihood of success when it is managed effectively. All too often, technical change is introduced in corporations, small businesses, and service organizations without the provision of adequate administrative support, such as management policies, staff development, and the commitment of fiscal resources sufficient for continued maintenance and necessary upgrading of the equipment (Kraemer & King, 1986). In a study of innovation in 85 public libraries, Damanpour and Evan (1984) found that when administrative change supported and facilitated technical change, optimal results were more likely to occur. This notion is reinforced by a study examining computer implementation in schools across nations (Brummelhuis & Plomp, 1993). That study revealed that the introduction of computers in schools often lacked administrative support, resulting in a restricted level of computer use among teachers. Teachers participating in the study frequently complained about the absence of assistance for managing, operating, and maintaining computing equipment (Brummelhuis & Plomp, 1993).

The management of activities involving computer innovation originated haphazardly in the local schools that I visited during the first phase of the study. Typically, it was undetermined as to who would perform simple tasks such as locking and unlocking the door of the computer lab, booting up the equipment, or loading paper into a printer, let alone more important duties such as maintaining the machines, keeping track of software, or ordering necessary supplies. These tasks occasionally were left undone, resulting in computers that remained untouched for weeks on end in some schools.

Eventually, most schools designated one or several people to oversee the basic tasks associated with computer management. Math teachers occasionally assumed responsibility for managerial tasks probably because of the traditional association of computers with math and science. In several schools, the librarian found herself faced with equipment and software management. Other schools relied on help from their community parents. Volunteers within schools often became recognized as champions of change, many of whom later became more formally involved with computer implementation by serving on technology committees.

Champions of Change

On the introduction of technological change, effective management often includes reliance on "champions" (Beath, 1991; Kanter, 1983; Pennings & Buitendam, 1987). Champions are workers who actively promote and manage the use of the new technology among other workers. They frequently encourage and influence others to overcome skepticism or avoidance of new technology. Champions are most effective when they receive organizational support, such as adequate access to information, material resources, and political backing (Beath, 1991; Kanter, 1983).

Inevitably, as I talked with teachers, they recalled a few faculty members in their schools who embraced the challenge of computing early on in the implementation process. These teachers were recognized by their colleagues as champions, and administrators relied on their good will and enthusiasm to carry the concept of computer innovation to the rest of the faculty in their schools.

Over time, computer-related responsibilities grew to such large proportions that one or two teachers could no longer be expected to manage these tasks without additional assistance or a reduction in their other responsibilities. At that time, schools started taking steps to provide more consistent management procedures. Typically, they began establishing technology committees. Later, they designated personnel to act as computer coordinators, a topic that will be taken up in Chapter 6.

Technology Committees

Technology committees (usually composed of champions) formed to help manage their schools' computer-related tasks and promote change. Often, a committee functioned as a *change facilitator team,* a term used by Hall and Hord (1987) to designate a small group of individuals who work together to achieve change in their school. Members of change facilitator teams should be knowledgeable about the innovation, trained in facilitation techniques, and provide opportunities for others to participate in leadership (Hall & Hord, 1987). Change facilitator teams can be an integral part of successful change in schools.

Whereas computer committees potentially were quite powerful as they became responsible for developing policy, writing grant proposals, and generally overseeing the computer implementation process in their schools, these committees actually were, and often continue to be, somewhat ineffective for reasons including poor representation and territoriality.

Ideally, the committees will reflect the computer-related interests and concerns of administrators, faculty, parents, and students. They may also benefit from the input of outside business linkages. Even so, the committees that I encountered were composed exclusively of teachers. Moreover, the committees typically had from three to eight members but, in most instances, far fewer members were involved actively in technology management. It was common to find committees that met once or twice sporadically throughout a school year and relied on only one person (usually a computer champion) to fulfill committee functions. For example, one public school teacher told me there were six teachers who served on her school's technology committee, but she quickly added, "Usually I'm the only one that does anything. Our principal views this as a one-person job. Last year we said we had a larger committee because of a grant we had applied for but like I said, usually I'm the only person."

In addition to poor representation on these committees, membership also tended to be somewhat territorial. Typically, turnover of membership on technology committees was low, with most members having served on their school's committee since its inception. Many of these teachers perceived their school's computer program as their "pet project," having shaped it to meet their own concerns. These teachers enjoyed a certain amount of status and recognition for serving on their technology committee. Perhaps for these reasons they were unwilling to rotate membership or to encourage other teachers to become involved in committee work.

When discussing this issue with the principal of one public school, she offered a contradictory opinion regarding turnover. She said, "I think it is likely that the same people are on this committee now as when you visited our school several years ago. People join these teams based on their skills and interests. There's a reason some teachers aren't on the technology team. They just aren't ready yet. They aren't interested." Regardless of whether low turnover was due to territoriality among members, a lack of interest among the other teachers, or their desire to remain uninvolved in shaping change for other reasons, it most likely discouraged potential participants from aspiring to become involved.

Working alone or together, individual champions and technology committee members fulfilled various computer-related management activities, including scheduling, minor equipment maintenance, faculty training, and curriculum guidance. Faculty training through staff development developed into an integral part of the computer implementation process.

Staff Development

Staff development is an ongoing activity in most school districts as educators refine their teaching strategies and expand their knowledge and expertise in various instructional areas. Staff development takes on a particularly critical role in the process of computer implementation. Teachers must have ample opportunity to gain knowledge, familiarity, and experience with computer equipment and software to use computers successfully in an instructional setting. Despite the underlying importance of staff development, lack of knowledge and insufficient training among teachers have been identified as two major problems in computer implementation (Reinen & Plomp, 1993).

Locally, the public school district recognized the need and value of staff development early on. At the time that public schools began installing computer labs, the district initiated a support unit that organized group training sessions and provided technical assistance to computer users within schools, districtwide. Even though assistance was somewhat limited due to the resources available, the unit represented an important centralized source of knowledge and expertise relating to computer implementation.

The support unit devised a creative program encouraging teachers to engage in a combination of peer tutoring and group training. It called for five teachers from each school to participate voluntarily in an intense 60-hour computer workshop during their summer vacation and rewarded them with a one-time stipend for their time. In exchange for the training, the district expected these teachers to return to their respective schools the following semester and assume responsibility for the implementation of the computers on a schoolwide basis. Their duties included the promotion of the general use of computing equipment in their schools and limited staff development.

It became clear as I talked with principals and teachers that many schools did not consider the issue of staff development until after computer labs were installed. An administrator in one private school admitted that his school had erred by not providing training to its faculty in the earliest stages of computer implementation. He said, "We thought teachers would seek help when they needed it. After all, they're professionals, right? For that reason we didn't offer formal training at all." He explained that with no expectations regarding computer use conveyed to teachers, by and large, the computers sat unused for several years. As a result, the school was in the process of planning its first formal training session while I was there.

Staff development generally took the form of either informal peer tutoring among faculty members or, on a more formal basis, group training sessions. Usually, these training options were available to teachers at various times throughout the school year and were designed to familiarize teachers with new equipment, its operation, and some of the accompanying software.

Peer Tutoring

Peer tutoring offers many benefits and some disadvantages for staff development. The most obvious advantage to this approach is that by sharing the same work environment, a peer tutor may be better able to understand and address the needs and anxieties of the tutee at a personal level. After all, who is more familiar with schools and daily concerns of teachers than fellow teachers? In addition, peer tutoring can reduce the apprehension a teacher may feel when learning new skills because it usually occurs in a small group setting or on a one-to-one basis. On the other hand, there are drawbacks to peer tutoring that may interfere with successful staff development. For instance, peer tutoring can be a "hit-and-miss" activity. Whereas some teachers may readily seek peer tutoring and benefit from it, others may avoid it altogether.

Over the years, many teachers in need of guidance in local schools avoided seeking help from their colleagues willing to train them. Even when tutors openly volunteered to stay after school and guide others, they commonly found themselves alone in the lab. Those in need of assistance often told me they avoided tutoring because they hesitated to impose on the good will and time of the tutors. One fifth-grade teacher commented,

> The intentions of people are wonderful and I think they have overworked themselves in most cases. But I think we are asking too much of them. We're trying to put somebody whose job is to teach fourth-grade math in a lab and ask them to use their free time to support us. I feel real uncomfortable going to those people and asking for any extra time.

Group Training

An alternative to peer tutoring is staff development through group training sessions. Usually these sessions are much more formal. They may have a predetermined agenda and larger attendance. The advantage to group training is that it may be more efficient and uniform than peer tutoring.

Even so, group training sessions were problem filled in the early stages of computer implementation. Commonly, they were conducted by consultants representing computer vendors who knew a great deal about the technical aspects of computing equipment but were not necessarily sensitive to the work environments of elementary school teachers or familiar with strategies of elementary classroom teaching. Teachers criticized those sessions, feeling that they were overly technical and lacked practical application. They claimed that the detailed presentations seemed overwhelming and irrelevant to their own work routines. Frequently, I heard comments such as "It was much too fast," "We couldn't keep up with the trainer," or "I was lost." Consequently, most teachers with whom I spoke perceived group training sessions to be moderately helpful at best, and attendance was frequently poor. The sessions often were counterproductive. Rather than feeling encouraged to experiment with new equipment, teachers were less likely to want to use it.

In an attempt to avoid problems such as the expense and ineffectiveness associated with sessions conducted by "outsiders," school administrators occasionally asked members of their own faculties to present training sessions. Sometimes these were effective and other times they were not. A woman responsible for presenting a training session in her parochial school recalled her own observations:

> The principal here asked me if I would put on a training session for the other teachers. I showed them all how to turn on the computers and how to insert a program. I showed them how to play with just one piece of software, how to use it. I think at that point they all decided they really wanted no part of it. Either they just didn't want to take the time to do it or they didn't see any use for it.

Additional Training Issues

Other factors restricted the success of training sessions. The first of these involved a lag in time between computer acquisition and computer training. In the early years of computer implementation, teachers sometimes had machines long before they even knew how to boot them up. In other instances, they received training too far in advance of having access to the hardware or software. One public school teacher remembered her first training experience as follows:

> It was a good "inservice." They were all prepared and did a good job. I don't think you can teach people everything they need to know about computers in one inservice, but they did a nice job. The only problem was that our school didn't get its lab up and running for 6 months after that training session. By that time, everyone had forgotten everything they had learned about computers.

A second-grade teacher from a parochial school shared similar sentiments. She complained that "software menus seem meaningless to us unless we are actually in those units at the time of the training. Otherwise, by the time we get to those units we've forgotten what we needed to know in the first place."

The time of day that training sessions were held also factored into their success. Teachers often resented computer training if it was held after school, a time when they felt they should be free from school-related responsibilities. They held the perception that after-school time should be for tying up loose ends and winding down, not for learning something new. A fourth-grade teacher complained, "I wouldn't have minded going to training in the summer, but after-school time is sacred to me. I hated being asked to give that up." Another woman, having recently conducted a training session at her school, shared a similar observation. She said, "Some of the teachers came to the inservice and talked through the whole presentation. I was so mad, I thought I was going to lose my cool." She attributed the rude behavior that she encountered, in part, to the fact that the training had been held after school. She explained, "That's not a real popular time. The teachers didn't want to be here to begin with."

Another factor influencing the success of staff development efforts was that training typically lacked reinforcement through curriculum guidance. A few schools provided "curriculum guides" ranging from a sheet of paper containing basic instructions in machine operation to rudimentary lists of available software, but most schools did not provide any curriculum guidance whatsoever. When asked if she knew of any curriculum guidance in her parochial school, one teacher responded, "I'm not aware of any. If it's here, it's probably just in a folder somewhere in the teachers' lounge."

As expectations regarding computer use increased, curriculum guidance in some schools became more obvious. The public school system, for instance, began cataloguing the new software available on the networked system. A third-grade teacher noted, "We get a listing of all the new software. It is coded in terms of which is appropriate for fun and which ones are for learning, but still I don't know what to use for what." Generally, curriculum guidance remained scarce and ineffective. If it was absent, teachers complained that they did not feel any incentive to accomplish any specific lesson with computers. When it did exist, teachers expressed dissatisfaction with its usefulness. In effect, whether curriculum guidance was available, few teachers reported using it.

Current Trends in Staff Development

Because of the ever-increasing availability and diversity of software and new hardware, ongoing staff development through supplementary computer training and guidance continues to be available to most teachers. Presently, more than ever before, teachers seem to have viable options for professional development involving computing that address their individual skill levels, needs, and personal interests. Though it is apparent that there were some problems regarding staff development with computers early on, many schools presently are showing signs of real progress in this area. Problematic issues either have been resolved or are currently under examination for improvement.

The most noteworthy advances include the following:

1. Staff support units within school systems and among vending companies have begun to recognize that the interpersonal skills of a trainer are equally important (if not more so) as

technical skills. Vendors have made strong attempts to familiarize themselves with school environments, teacher needs, and strategies of instruction.

2. As computers themselves have become more user-friendly, software has become less complex and more streamlined. At the same time, training sessions have become more narrowly focused and targeted to users based on their skill levels and needs. One user described her most recent training experience. She said, "Last summer I went back and took a six-hour inservice, and it really did me a lot of good because it brought me up to date on the changes in this particular software. The company took out a lot of the barriers, the glitches in the program that made it hard to use. And now it has gotten more fine-tuned to make it easier. It's a wonderful program. I'm really glad I took the new training. It was great."

3. Some schools continue to recognize the value of having teachers with stronger computer skills offer peer tutoring. An administrator in a private school indicated that peer tutoring is a successful aspect of staff development in his school. He said, "A lot of people are thinking, 'I don't know how to use a computer, what can I do?' And other teachers are saying, 'Come on, let's go in my room and sit down without anybody knowing anything and I'll show you what I know.' I think a lot of that goes on."

4. Some teachers are beginning to develop and rely on networks they have established over the years with other strong users. One such user explained, "Most of my training and technology knowledge comes from networking with other people. It's real efficient." No doubt, this will become an increasingly important aspect of staff development as electronic communication makes its way into elementary schools in the coming years.

Despite advances in staff development, problems still persist. Some of these problems and possible solutions are as follows:

Problem 1: Individual and group sessions held after school still continue to be less successful. One teacher who volunteered her time for peer tutoring said,

> A lot of times teachers come and say "Could you show me this one more time?" And I usually have classes after school where I'll set up a topic. This week we're going to talk about programming, or this week we're going to talk about how to use the spooler for the word processor. And then we'll do it after school. I'll have classes like that set up for teachers who want to come."

When I asked her about attendance, however, she admitted that only one or two teachers usually attended the sessions. Through conversations with teachers, I discovered that most of them remain unaware and otherwise disinterested in any training that was offered after school. In addition, they persistently complained of a lack of time either to continue training on their own or to practice what they have learned in a training session.

Solution: By hiring substitutes or channeling parent volunteers, a few schools have begun releasing teachers from classroom responsibilities so they can obtain computer training or refine their skills during the school day rather than after school. Often, this training occurs through peer tutoring or individual practice and experimentation, but the important point is that it occurs on school time rather than personal time. The success of this tactic is twofold. In addition to acquiring, refining, and sharing computing skills among teachers, the practice of releasing teachers from other responsibilities temporarily allows schools to demonstrate to teachers that they value staff development and are willing to commit or redirect resources to promote it.

Problem 2: Time lag continues to be a problem that impedes staff development. For example, the teachers from one public school recently explained to me that, in anticipation of acquiring laptop computers in their school, their principal insisted they attend a two-day training session held away from their school in late summer. One teacher explained, "We went through a whole two-day session last summer in preparation for the laptops but they were never delivered to the school. Everyone was so excited about it but since the equipment never came it's become kind of a joke." Another teacher in the same school commented, "The teachers have been angry that we didn't get our computers when they told us we'd get them." Later she added with disgust, "Now the school board is promising delivery by August of this year so we'll have to be retrained."

Related to this problem is another whereby teachers are trained on powerful, state-of-the-art equipment but have only older, less powerful equipment available to them in their home school. Teachers in several schools complained that it was confusing and discouraging to learn new techniques or new software in training that they could not apply.

Solution: To avoid or counteract problems stemming from a lag in time between when teachers are trained to use new equipment versus when they have access to that equipment, some schools have begun arranging for trainers to conduct sessions at schools rather than elsewhere, and scheduling the training immediately following the acquisition of new equipment rather than before. Training held in familiar surroundings using in-house equipment can increase the likelihood that the sessions will be more productive and can reduce anxieties among users associated with technological change.

Problem 3: Teachers feel they continue to lack strong guidance to assist them in developing strategies of computer implementation. One teacher was not particularly optimistic. She said, "The way computers are changing, I think I forever will need more training just to keep up. But I'm not sure that I can get what I need. I'd really like some kind of direction on how to put together a fine computer program. I'm just stumbling along and what works, okay, works, and then next year I'll change what didn't." Other teachers echoed this concern.

Solution: Although this problem remains one of the most baffling, some schools have begun to address it by encouraging their teachers to engage in dialogue and knowledge sharing with educators across schools. These teachers engage in brainstorming, problem solving, and guided experimentation. When they discover and develop strategies they find successful, they are encouraged to document those successes so that other teachers can use them for future reference. Finally, some schools encourage teachers to participate in technology conferences that provide additional opportunities for information acquisition and strategy sharing across school districts.

Discussion

This chapter has outlined the experiences of local elementary schools on the introduction of computer technology. On reviewing the various aspects of computer implementation, we can see that, from the very start, organizational problems involving the flow of technical change, goals, management, and staff development impeded the implementation process.

Technical innovation is most successfully introduced by workers in organizations to solve job-related problems. The idea to innovate with computer technology, however, originated outside local schools, and computers were supplied to teachers prior to their demand. Consequently, a question of relevancy arose among educators and was not addressed adequately. Until teachers could recognize performance gaps that were best solved by computers, it was unlikely that they would perceive the equipment as relevant or important to their job of teaching.

Clearly defined goals and policies, sensitive to the concerns and needs of users, promote effective innovation, yet these were omitted in the process of computer implementation in local elementary schools. Although school communities advanced technical change with computers, perhaps because of its capacity to lend efficiency to schools, enhance instruction, and increase the quality of education, other more immediate and narrowly focused concerns, particularly the acquisition and use of computing equipment, gained salience among educators.

Technical change depends on a strong program of management; however, the management of computer implementation in local elementary schools began as an informal and largely unplanned activity. Teachers voluntarily assumed various responsibilities as they arose, such as scheduling, cataloging of software, and so forth. Eventually, computer champions and computer committees began managing the process of computer implementation in their schools. By encouraging teachers to manage their colleagues, these arrangements prevented computing activities from being imposed conspicuously from the top, thus enabling school administrators to keep a low profile. Teachers most likely derived mixed messages from the arrangement. In the absence of strong administrative commitment, it is probable that teachers questioned the degree to which administrators supported computing activities.

Finally, successful change with new technology requires an investment in staff development. Training, through either group sessions or peer tutoring, can be an effective means to disperse computer information to teachers, but computer training for teachers in local schools often was unproductive. Training commonly focused on technical aspects of computing rather than its curricular value. A lag between the time of instruction and the opportunity to apply the instruction often made training irrelevant. Either teachers had access to computers before they knew how to boot them up or training sessions were held so far in advance of actual computer implementation that teachers did not retain the details of their instruction. Training offered after school disrupted teachers' traditional expectations regarding their workday.

Though schools might have had responsible intentions regarding the process of computer implementation, the lack of meaningful direction regarding computers did not stimulate or reinforce interest in computing activities among most teachers. Rather, the process of implementation violated the occupational norms of teachers. Teachers were asked to implement a technology with which they often were unfamiliar and that they perceived as irrelevant to their teaching agenda. Teachers were managed by other teachers while, in many instances, administrators watched from the sideline. Finally, teachers were expected to extend their working day or otherwise forfeited their personal time to advance staff development. Consequently, instead of promoting interest in computer activities, the process of implementation frequently generated feelings of frustration, confusion, and resentment among teachers.

The implementation of change is critical to its success. Although teachers may exercise their professional autonomy in the innovative process, it is the way that change is introduced, managed, and promoted that will motivate teachers to integrate new technology into their work routines. It is likely that because of the organizational problems that teachers in local schools encountered throughout the implementation of computers and because many teachers perceived the innovation as a threat to their occupational culture, motivation to use computing equipment faltered. Chapter 3 examines the sources of motivation that promoted the use of computers among teachers. The chapter presents evidence that demonstrates that in innovating, teachers responded to informal rather than formal motivational factors.

3

Motivating Teachers to Change

Daily, teachers encounter features in their work environment that encourage them to use computers. It might be the location of the equipment itself or a schedule hanging outside a lab door that acts as a reminder for teachers to reserve computer time. It could be comments offered by an enthusiastic computer user in the teachers lounge, describing a particularly intriguing software program that entices teachers to consider using computers. It might even be students who unceasingly badger their teacher to let them "play the games," or parents who drop not so subtle hints about their child's computing activities during a parent-teacher conference.

Motivations for workers to address organizational expectations, including those necessary for technological change, typically stem from organizational features that influence and shape workplace behavior. These features vary, however, in scope and in source. For instance, behavioral motivators can emerge from formal, structural, hierarchical sources of authority. On the other hand, in some organizations such as schools, where workers have a high degree of occupational autonomy, special motivational arrangements emerge that are more distanced from hierarchical constraints.

The promotion of computer use among teachers in elementary schools is a case in point. Considering various organizational features that promote conditions of technical change, this chapter investigates the elements of the work environment of teachers that encourage them to use computers. Through their computing activities, teachers are responding to multiple sources of motivation or influence. Whereas formally structured incentives may produce change successfully in other organizations, motivational factors stemming from informal sources have more salience for elementary school teachers. These sources serve to reinforce the organizational structure of the school while effectively eliciting innovative behavior among teachers.

Formal Incentives for Change

Organizations often provide formal incentives to gain desirable behavioral effects among workers (Scott, 1981). In the case of technical innovation, at least two types of formal incentives, including explicit policies or strategies for evaluating change and extrinsic compensation for rewarding change, may exact movement toward organizational goals. Neither of these, however, tended to be available to teachers as local elementary schools introduced computers.

Formal Evaluation

A formal evaluation program can effectively motivate workers to use a new technology such as computers. Evaluation can be formative in that it measures progress achieved in the innovative process, or it can be summative, whereby evaluators assess end progress or products resulting from the change (Brewer & DeLeon, 1983). In both instances, evaluative results can illuminate some of the more apparent problems in the innovative process, such as individual performance gaps or program discrepancies, enabling administrators of change to redirect implementation efforts when necessary.

Evaluation can motivate workers to conform to organizational goals particularly when organizational expectations regarding changes in job performance are defined and progress toward achievement is assessed with evaluative measures. Blau (1974) found that when one government agency kept statistical records of worker performance, productivity increased. Although the workers resented some of the evaluative measures and frequently developed innovative ways to covertly enhance their performance ratings, they tended to concentrate their efforts on those tasks for which they knew they would be held accountable. Consequently, performance improved. Blau concluded that the evaluative activities facilitated administrative control of workers and promoted their conformity to organizational goals. Evaluative programs in the innovative process can be constructive, then, not only because they assess change but also because they motivate workers to respond to organizational goals regarding change and consequently, promote and enhance program performance.

Absence of Formal Evaluation in Schools. Although evaluative activities may effect positive outcomes in the process of change, principals from local public, private, and parochial schools reported that to their knowledge, there had not been any formal, systematic evaluation of school computing programs in their schools. Neither administrators nor faculties seem overly concerned with the lack of evaluation of their school's computer program.

Despite the absence of formal evaluation, coordinators at the school-district level in the local community believed that they had a good "feel" for the ways in which computers were being used in schools. A spokesperson for the public system stated that the test scores of public schools were monitored continually and that a recent slight increase in scores had been attributed to a possible link with computer use. Even so, she admitted that the anticipated relationship had not been rigorously tested.

One explanation for the apparent lack of formal evaluation of computing in schools was the absence of clear-cut, measurable goals to drive the process of change initially. Goals serve as a standard with which to judge success (Conrad, 1974). For a meaningful evaluation of innovation to take place, an organization needs to define concisely a set of technical problems that are to be addressed by change. Ideally, criteria involving efficiency, adequacy, and effectiveness are assessed. As Chapter 2 indicated, schools, for the most part, innovated with computers in response to a flow of change emanating from the local school community rather than from within schools themselves. Through computer implementation, schools were better positioned to appear rational and sustain legitimacy in the community. Legitimacy, however, is something that is not easily measured or quantified, thus reducing the feasibility of evaluation.

Evaluation in public service organizations, including schools, is difficult to measure due to the nature of goals driving change. Because the goals of these organizations commonly are absent or ambiguous, the assessment of progress toward goal realization becomes more difficult. In his study of a police department, Brown (1981) found that goal ambiguity persisted because of contextual elements within the local community in which the police operated and that, in turn, inhibited departmental program evaluation. Neighborhood crime demanded police attention, but the complex social makeup of the community very often contributed to vague and ambiguous societal expectations of what police should do, thus creating multiple goals for the police (Brown, 1981). In this instance, client-centered expectations varied from the more rational, organizational goals regarding crime held by the police department. Nevertheless, the department attempted to respond to both. Because of goal ambiguity, job performance and program effectiveness were more difficult to measure and evaluation became more unrealistic.

A second explanation of the lack of evaluation of the process of computer innovation in schools focuses on the lack of accountability to school boards required of schools generally. Schools in the United States historically operate somewhat autonomously and are afforded wide latitude in the way they can implement policies and procedures. Examining the relation between school boards and principals, Peterson (1984) identified the means by which the administrative behavior of principals was hierarchically supervised and controlled. Of six types of controls, the assessment of output of individual schools, as measured by the test scores of students, was the type used by school boards most effectively and with greatest frequency. This control measure is easily administered and unobtrusive because it interferes with the actual operation of a school to a minimal degree, if at all. It does not qualitatively assess effectiveness of individual programs nor address specific methods of management within schools. The control measures most frequently relied on by school boards may actually promote flexibility and discretion employed by principals when managing their own schools.

Limited Evaluation Within Schools. Just as a formal evaluation of computer innovation in schools was not conducted at the system level, there was a lack of systematic assessment of computing within local schools as well. For instance, a coordinator in one Catholic school remarked, "We have Mrs. Smith from the Catholic School Office. She was supposed to come out a couple of times and she didn't make it. And as far as I know, there is no evaluation from the principal." When the principal of that same school was questioned about evaluative practices, she responded, "I walked over to the lab once and observed it. I've even committed money to it for next year." Her comment suggests that, though she financially supported the lab, this principal had not assessed activities that occurred there. Although most of the principals said they had observed the lab in their schools a few times over the years, evaluation clearly was not a routine activity of most administrators.

Lacking formal evaluative measures, three principals from the public system reported that, on occasion, they assessed the level of computing activities in their schools in other ways. These assessments, each focusing on different aspects of the innovation, satisfied different interests for the principals. The first two principals emphasized assessment of a summative nature and the third principal conducted a formative evaluation. In each of the three schools, evaluative criteria were measured at a very general level.

The first principal, a veteran administrator of 9 years, indicated that she was most interested in determining the extent and level of computer use in her schools by teachers. She evaluated the school's use of computers by marking the amount of computer paper that her school ordered:

> I have watched this evolve in various phases, and now I think the phase that we need to be in next is more word processing, some writing of stories, and more computer printing. I can tell that we're not there yet because I'm not buying enough paper.

In her opinion, teachers in the school were not yet using the machines at an optimal level because they used a minimal amount of computer paper. This principal noted, however, that the paper order had slowly increased each year, a trend that she interpreted as progress.

The second principal focused on performance outcomes of students to reflect the usefulness of computers in her school:

> I'm hoping that this year's test scores will show how the computer helps. Our teachers have been using a spelling disk so I hope it helps test scores. If it does, then I think teachers will feel more motivation to use the computers to do well.

This principal relied on performance outcome indicators for two purposes. First, she implied that the test scores would reflect information about the general use patterns among teachers. If test scores increased, she would safely assume that teachers were using the spelling disks. Second, she indicated that she would rely on successful test score outcomes to promote use of computers among her faculty. Beyond tracking student scores, she did not recognize a need to assess the use of the equipment at all.

The third principal considered the qualitative ways that teachers used computers at his school. He and his team leaders among the faculty maintained an ongoing watch on the implementation process in their school. He described the following:

> We are looking at ways of doing more with computers to determine what's going on and to be able to make changes before we go a whole year and then say, "Gee, we didn't do so good. Maybe we ought to make a change next year." We can alter our course as we go along if we're looking at certain types of data that are coming out in the classroom. Teachers can determine if something is not working and do something about it.

Only this principal acknowledged actually encouraging and taking action as a result of the evaluative findings.

Significantly, in all three of the evaluations, performance measures were vague, unsystematic, and unobtrusive. None of the evaluative criteria required direct observation of computer users. Rather, by measuring amounts of computer paper, monitoring test score outcomes, or encouraging teachers to examine their own behavior, principals remained informed of the innovative progress of the school without overtly measuring it or imposing controls on teachers.

Similar to patterns characterizing the supervision of principals by district administrators, the evaluative activities pertaining to computing in local schools reinforce the notion that the accountability of teachers to principals commonly is limited (Lortie, 1975; Tyler, 1985; Weick, 1976). A study of elementary schools in the San Francisco Bay area revealed that only 12% of principals reported having real decision-making power over teaching methods in their schools, whereas that rate was much higher for control over administrative functions such as scheduling, pupil assignment, and hiring. The researchers concluded that schools only marginally controlled their central instructional functions (Meyer & Scott, 1976). The absence of formal policies, either promotional or evaluative, regarding computing activities in local schools reinforced the discretion of teachers throughout the process of implementation.

Reward Incentives

Reward incentive, a formalized system tying compensation to worker performances, is another motivational strategy commonly used in organizations to elicit change. Personnel who achieve, produce, or move toward desired organizational outcomes are rewarded. Ideally, organizations will begin offering extrinsic incentives to workers at the same time that change is introduced. Generally, the relationship between job performance and reward predicts that behavioral change is more likely to occur when remuneration of effort is forthcoming (Duncan, 1978). Opponents of incentive programs argue that extrinsic rewards deprofessionalize workers by enabling supervisors to gain greater control of the workplace. Edwards (1979) found that characteristically, bureaucratic organizations introduced elaborate positive rewards that functioned as bribes to elicit cooperation from workers. Nevertheless, incentives are appealing to workers and promote behavioral change. Peters and Waterman (1982) concur. In their examination of business organizations, they found a close link between incentives and productivity. Formal rewards regularly were extended to top performers.

Monetary rewards, in particular, are very significant in eliciting behavioral change among workers (Duncan, 1978; Edwards, 1979; Peters & Waterman, 1982). Typically, these include pay bonuses, stipends, or salary increases. In addition, many organizations find success by offering nonmonetary incentives as well, or a combination of both. For example, when examining the practices of Polaroid, Edwards (1979) found that control of worker behavior was enhanced when that company offered higher pay, more rights, and greater job security to workers.

Based on the positive experiences of other organizations when they used rewards as incentives for change, it seems that elementary school teachers would be more highly motivated to use computers if they were offered reward incentives, particularly monetary compensation, to do so. Even though computer implementation in elementary schools necessitated the acquisition of new skills and required change on the part of teachers, it was not accompanied by any formal incentive program. Some teachers, specifically those recognized as computer champions, often devoted much time and effort promoting computer implementation within their schools or developing important computing skills. As one teacher lamented, "This isn't something you can just sit down and learn in an hour." Even so, compensation was minimal. Early on, only those teachers from the public system who received intensive computer training in the first summer of implementation were paid any kind of stipend for their time and effort. On rare occasions, a teacher would be granted a planning period if she managed the computers in her school. Later, two schools paid their teachers a nominal stipend to attend a brief training session held during their summer vacation. For the most part, though, reward incentives designed to elicit innovative behavior were extremely limited.

More recently, administrators in the local school community have begun to consider the important role that monetary rewards might play in eliciting innovative computing practices among teachers. For example, the principal of one parochial school revealed to me that she planned to reward a teacher in her school for her effort to use computers. She said, "I intend to give her a bonus because she constantly looks for new ways to upgrade the computers and she is constantly looking for ways to help children gain."

Other schools have begun to offer money in the form of grants to entice teachers to consider innovative applications of computer activities for teaching. An administrator of a private school explained that his school awarded grants of up to $1,000 to teachers for summer research designed to improve teaching. Whereas the grants were not designated specifically for technology-related work, he admitted, "Anything that comes up with the word 'computer' is almost automatically approved." Although isolated episodes such as these represent important steps toward rewarding innovative behavior, the widespread use of reward incentives is constrained by the financial resources of schools and are likely to remain restricted in availability.

This limited use of formal incentives for behavioral change is characteristic of the reward system available to teachers generally. For example, teachers' salaries historically are based on certification levels and years of experience in the occupation, and salaries reflect non-performance-related measures (Clifford & Guthrie, 1988; Conely & Odden, 1995; Lortie, 1975). Only in recent years have school districts begun to explore offering teachers monetary rewards based on alternative criteria, such as good teaching, additional job responsibilities, or increased professional skills (Bacharach, Conley, & Shedd, 1990). Even so, many of the newer teacher compensation plans are problematic. They are difficult to implement, are viewed negatively by those teachers not receiving rewards and, because they disrupt collegiality among faculties, they violate occupational norms of teachers (Conley & Odden, 1995).

A Loosely Coupled System

Given the lack of evaluation and rewards, it is clear that computer innovation was not formally promoted among teachers in local elementary schools. Although it seems likely that an explicit system of evaluation coupled with rewards would have motivated teachers in local schools to use computers, for various reasons, including the absence of a clearly defined set of innovative goals and general lack of accountability, neither rigorous evaluative activity or reward incentives were part of the computer implementation process. These conditions reinforced a structural administrative arrangement in schools that heightened the professional autonomy of teachers.

Teachers typically enjoy a great deal of latitude in fulfilling their occupational role (Bidwell, 1965; Hall & Hord, 1987; Hanson, 1981; Lortie, 1975). Weick (1976) describes the power and control arrangements in schools as being a "loosely coupled" system. This is characterized by remote or weakly enforced connections between stable subgroupings within the organization, each of which maintains its own identity. In an elementary school, for example, teachers may be loosely coupled with administration. Each group is responsive to the other but also preserves its own functions, identity, and autonomy. Each group resists restrictions imposed by the other. In the school setting, then, we would expect that the principals derive consideration and compliance from faculty members but that teachers sustain a high level of autonomy.

Often the relatively low rate of successful innovation in schools has been attributed to the autonomy of teachers (Cohen, 1987; Cuban, 1986; Hanson, 1981). Theoretically, teachers can choose to ignore change and sustain more traditional modes of teaching with very little repercussion administratively. In fact, though, the teachers that I observed appeared motivated to display innovative computing behavior. If teachers were not motivated through formal programs of evaluation or reward for innovative behavior with computers, the question then becomes, What encouraged teachers to use computers at all?

Informal Incentives for Change

In the absence of formal motivators for change, other factors within the work environment of the elementary school teacher function informally as incentives for change. Some are particularly salient for teachers, and it is to those that teachers respond most consistently. These factors constitute conditions that affect dynamics of organizational change and can be grouped depending on whether or not they originate within the school itself.

Incentives in Schools

Motivation to comply with innovative expectations often emerged from sources found within schools. Whereas computer implementation lacked reinforcement through formal procedures, such as evaluations and reward systems, faculty members commonly encountered informal motivators promoting the use of computers through the leadership efforts of principals and champions, monitoring, the availability of equipment, and peer group control.

Leadership. The presence of effective leadership in schools is a fundamental ingredient in the process of change. Effective leaders are those who demonstrate enthusiasm and concern for change, communicate expectations and standards to teachers, have a recognized ability to give advice and support, engage in problem solving, and enhance the instructional qualities of the school (Friedkin & Slater, 1994; Hall & Hord, 1987). The presence of effective leadership in the process of change is related to school performance and student achievement (Hall & Hord, 1987).

Not surprisingly, leadership provided by school principals is critical in the process of computer implementation (Kearsley & Lynch, 1992; Wolf, 1993). Teachers may be more likely to use computers when they receive encouragement and support from school principals (Brummelhuis & Plomp, 1993). A study examining the principal's role in computer implementation revealed that principals with positive attitudes toward computing tended to stimulate positive attitudes among teachers. Moreover, there was a strong relationship between the principal's attitudes toward computing and the extent to which computers were used in schools (Pelgrum, 1993).

For the most part, the elementary school principals in the local community tended to avoid engaging in leadership strategies involving direct contact with computer technology. At the time of my first visits to schools, only one principal had a computer in his office and used it. When I returned to visit schools more recently, more than half the principals had computers in their office but, even so, the number who told me they used their computers routinely increased only to three. One principal discussed her lack of computer know-how in the following manner:

> I'm not into computing because, frankly, I don't have the time. I can give my secretary the work to do and she gets it back to me almost immediately. That enables her to improve her skills and mine stay weak. I can see where it

> would be advantageous for my teachers to see me using the machines, but I haven't gotten into it yet.

As with this principal, others usually recognized that it would be helpful to exemplify innovative behavior to their faculty and staff but, even so, most principals did not use computers.

This pattern did not go unnoticed among faculty members. For example, a math specialist in a parochial school told me that her school's principal recently had acquired a computer in her office. She said, "Maybe when our principal becomes more comfortable with her computer and understands how it can help, it might rub off onto teachers down the road. But I really don't see that happening. She's still very gun-shy about computers. I think it's just something she's not going to touch." A fourth-grade teacher from a public school explained the situation with her principal. She said laughingly, "Our principal doesn't have a clue. This summer he said he was really, really going to take training and learn computing. And he was going to make copies of his diploma and make sure all the teachers got one. I mean it's really quite a joke. He's going to have to be dragged into the technology arena. I don't see how he can expect much of us when he won't touch it himself."

Even though few principals in local elementary schools used computers, they typically tried to compensate for this shortcoming by attending group training sessions with their faculty. In all probability, this was as much or more to demonstrate their interest and support of computing to their faculties as it was to learn computer skills. Regardless of their underlying intentions, teachers received these efforts favorably. For example, one third-grade teacher commented, "We did our computer training and the principal went right through the same training with us. He came in on our in-service day and sat down at this computer. We thought that was great. We get a lot of encouragement from our principal to use computers." Clearly, this teacher was impressed that her principal would join his staff to learn computer skills. For this teacher and others, gestures such as these on the part of principals were interpreted as commitment to computer innovation.

In addition to principal leadership, motivation to use computers often depended on the leadership efforts of champions, computer committee members, and later, computer specialists to stimulate interest in computing among faculty members, particularly in schools where principals limited their own involvement in the implementation process. Recall from Chapter 2 that computer champions offered peer tutoring services and limited managerial assistance in schools, all with the intended effect of increasing computer use among staff. Also, these same individuals frequently attempted to create a positive, innovative climate among faculty by making suggestions or comments of encouragement to other teachers such as "Remember, if you need our help . . ."

Principals capitalized on the examples modeled by champions to promote computing. A principal explained,

> Computing is something you really can't push on teachers. Instead, we try to promote it by having teachers influence other teachers and we, fortunately, have some teachers who are very good at doing that. For instance, one teacher's children were producing such beautiful work that she posted it in the lobby on the bulletin boards. The work looked like high school work. It was just beautiful. I have to give her a lot of credit because I think that really did help spur on other teachers.

Another principal shared similar experiences. She said, "One of our teachers produced such a spectacular product with her class as a project that the others felt they should at least know something about the machine." Certainly some teachers became computer wizards and their expertise, as demonstrated by products such as the ones in the above episode, was bound to function as a motivator for other teachers.

Early on, scholars of technological innovation predicted that teachers would be more likely to use computers for instructional purposes if they saw computers being used for administrative purposes in their schools (Wolf, 1993). Findings from an international survey of computing in schools, however, revealed that most often the computing habits of teachers were more advanced than those of principals (Wolf, 1993). These findings, along with my observations regarding computing habits of principals in local schools, suggest that though the efforts of computer champions undoubtedly went a long way toward the promotion of computer use among other faculty members, the low use of computers among principals is an issue of computer implementation that deserves further attention.

Monitoring. A factor commonly associated with principal leadership is monitoring. Effective principals keep abreast of the instructional practices of their teachers (Hall & Hord, 1987). Hall, Hord, and Griffin (1980) found that, in the process of change, teachers used the innovation more consistently when principals demonstrated knowledge, interest, and concern about those innovative practices. Monitoring the innovative practices of teachers is one way that principals can become or remain knowledgeable about the process of change in their schools. In local schools, teachers commonly believed that no one monitored their computing habits whatsoever—either the frequency or strategies of use—and that principals remained oblivious to the computing patterns among teachers. In one interview session, a second-grade public school teacher admitted that she had not used computers with her students at all that year. She said, "Nobody has ever said, 'I notice you never go to the lab.' No one misses me there." Teachers in another school also acknowledged that there was no pressure exerted on them to use computers and related it to the low use of computers among their faculty. A teacher from the fifth grade said, "Computers aren't monitored at all in this school. That's why most of the teachers either don't use the computers or only use the lab for a baby-sitting facility." Agreeing with her colleague, a third-grade teacher commented, "I think our principal just doesn't want to rock the boat here." Other teachers throughout all the schools concurred with these impressions. I often heard comments similar to this one voiced by a fourth-grade public school teacher: "I don't think anybody ever checks to see if we use computers or not, so why bother?"

The absence of overt monitoring possibly was due, in part, to the location of computer equipment in the schools. For security reasons, computer labs were often located in rather inaccessible areas of the school, such as basements. One school's lab was located on the second floor of a building entirely separated from the rest of the school. Depending on the location of the lab, a principal may not so much as walk by the door of the lab for days on end. The use of computers that were in individual classrooms, likewise, was rarely observed. Classrooms traditionally are the domain of the classroom teachers and they are isolated from the patterns of communication and supervision within schools.

Natriello and Dornbusch (1980) found that the physical distancing of the classroom and lack of visibility of teaching itself are key factors contributing to infrequent supervision and evaluation of teachers by supervisors. Lortie (1975) concurs, noting that occupational characteristics, including the geographical isolation of classrooms, reduce the possibility of strict administrative control of teacher performance.

Another plausible explanation for the absence of overt supervision of computing activities was that administrators hesitated to infringe on the professional autonomy of teachers. The principal in one public school explained, "As soon as I would go in and say, 'Now you've got to do this and you've got to do that,' that would backfire. Teachers would resent it. I've never done that and I won't start now." In concurrence with this principal, another principal revealed the approach she used with the teachers in her school. She said, "I would rather not, as an administrator, say, 'I want you in there one time a week or whatever.' That wouldn't work. I would rather say to them, 'Use the computer lab as a resource when it's available. Use it when it needs to be used.' And then let them decide on their own when and how often to work it into their schedule."

These principals were willing to sacrifice the potential for increased interest in computing among teachers to respect more fundamental norms associated with the loosely coupled relationship between administrators and faculties. In fact, overt, intrusive strategies of supervision are negatively related to school performance (Friedkin & Slater, 1994), suggesting that less intense, indirect forms of supervision or monitoring may more successfully motivate teachers to use computers.

Even though principals or others did not overtly monitor computing practices, many teachers anticipated that their innovative behavior was monitored in more casual, covert ways. A fifth-grade teacher in a public school said, "The principal here is very subtle. In faculty meetings she may say 'It's great to see some of you people using the computer lab more.' Then you don't know if she's really been down there and watched or not." Another public school teacher said, "Now that students must submit portfolios at the end of the year I'm sure our principal will be checking to be sure there are some examples of children's work done on computer."

Believing that closer supervision might motivate individuals to use computers, some teachers favored increased monitoring. One teacher suggested, "Everyone is supposed to submit their lesson plans on a weekly basis. So while our principal is checking a plan book, she could check to see whether there is a computer lesson of some sort or not if she wanted to. Then we'd have to start doing something with the computers here." Other faculty members hoped that if principals increased their monitoring activities they, in turn, would receive more effective guidance regarding computer applications. A third-grade teacher voiced her concerns:

> Maybe if our principal paid more attention to what's going on she'd realize that, because there is no set mandate, the teachers don't have a plan and we are just hit-and-missing. If teachers don't have an order to follow, they won't see computing as anything they have to do, so if they don't get anyone on the computer today, it's no big deal. If there is a curriculum and if there is a directive that this is to be used so many hours a week in the lab or in your classroom and we were held accountable, then I think more would be accomplished. We would use computers if we had to.

Though principals did not hold teachers accountable for computer use early on, they seemed to be moving toward the use of more overt directives regarding computing more recently. On revisiting a public school where the previous principal had not used computers or attended to the computer program, I met a new principal who grappled with the problem of low use in her school. She intended to confront the situation by voicing her concerns about computing to the faculty in a formal meeting. She said,

> The dismal use of laptops and printers is on my agenda for the faculty meeting tomorrow. We are going to talk about the fact that I want to see them being used. After I've said that I am going to begin little visits to classrooms and observation walking through the building. Then if I still don't see computer use happening, I'll speak to that individual teacher.

A few other principals acknowledged that they would intervene if they perceived a problem with the lack of use of computing equipment in their schools. One public school principal told me, "If I get the feeling that they aren't being used, I would call the school board coordinator for help, but I don't feel that we have that problem. However, I don't go and ask or check up on anyone either." One parochial school principal said that he would go so far as to replace a teacher who did not attempt to use computers. He stated, "The bottom line is that I would get rid of a teacher if she does not use the computers."

Although these principals and others indicated that they would intervene, most of them avoided overtly monitoring computer activities in their school, perhaps deliberately, so that they would not have to confront the issue and take action. For the most part, principals respected the autonomy of the teachers. They continued to maintain an unobtrusive, low profile in the process of computer implementation by resisting overt administrative control and lending support indirectly.

Availability of Equipment. Another factor influencing computer use among teachers is equipment availability. Lack of equipment and limited accessibility of equipment commonly are cited as factors inhibiting the computer implementation process (Becker, 1991; Brummelhuis & Plomp, 1993; Lieber & Cosden, 1989). Interestingly, however, principals are more likely to view equipment availability as a deterrent to computing than are teachers (Brummelhuis & Plomp, 1993).

Assuming that greater access to computing equipment would motivate teachers to use it, schools attempted to make computers increasingly more available to teachers. One strategy intended to stimulate interest in computing was a lending policy whereby teachers were encouraged to take computers to their classrooms as well as to their homes for experimentation and practice. This represented an effort to informally generate and encourage interest in computing among faculties and has been a very successful motivational strategy for other organizations. For example, when the policy was introduced by Hewlett Packard, it was discovered that employees learned more about the new equipment while it was in their homes. Consequently, the company's commitment to innovation was reinforced (Peters & Waterman, 1982).

This policy was prevalent particularly in the parochial and private schools in the early stages of implementation, and, more recently, public schools also began encouraging teachers to borrow equipment. A teacher explained, "The teacher in charge of the equipment in our school keeps telling us to 'Take those computers home. Take them home for the summer. Take them home on weekends. Call me at my house if you have a problem.' "

Even though teachers were encouraged to borrow computing equipment, this particular policy was not used greatly by teachers that I spoke with, mainly because they perceived computers as expensive and temperamental and wanted to avoid responsibility for costly repairs in the event of breakage. Recently, however, a teacher who managed the technological equipment in one public school said that since her school got laptop computers, teachers were becoming more willing to experiment with the equipment at their homes. She commented hopefully,

> I just think that any time we can help to de-mystify computers we should. You know, let teachers put them in the case and take them home and bring them back. Even if they just go home and play "Number Munchers" or

> something, they learn to plug them in, turn them on, play on them, and bring them back. From that teachers see that the computers don't break and they are fun.

More recently, schools have begun making computers more available to teachers by purchasing additional machines and by redistributing machines within the school building. One principal explained, "I think teachers need to feel more comfortable with computers. There's still a lot of intimidation at this school. It may come from not having enough access. Therefore, I'm trying to get fifteen 'floaters' that teachers can reserve and use when they want." Another principal concurred. She told me, "If you don't have enough equipment you can't do much with your class. I think we need to have more computer access right in the classroom. The labs are great but teachers also need access in their rooms so I'm trying to get our PTA to buy new computers right now." In another conversation, a computer specialist from a private school said, "I've been thinking quite a bit about this lately. One of the needs that we have is a new lab in close proximity to the old lab and also close to the classrooms. Then we would use both of those labs as efficiently as possible to be able to carry out the curriculum."

Agreeing with these respondents, quite a few other principals along with faculty members told me they believed that greater access to computers would increase the probability of them being used, particularly by students. One principal whose school had recently bought a set of 30 laptops explained, "When you don't have daily access to what you want to use, then you don't use it. That's one of the reasons why we felt the laptops would be more advantageous. Then at least if the computers were right in their classroom, children could feel more comfortable using them on a daily basis." This comment suggests that student use of computers rather than teacher use was, perhaps, the more salient concern for this principal. Sharing this concern, a second-grade teacher who was perceived by other teachers in her school to be a champion of computing explained, "I'm hoping that if we can get computers into the classrooms, for one thing, students will teach the teachers how to use them."

Peer Group Pressure. Peer group pressure stimulated interest in computing among teachers in local schools. For example, reserving equipment was one tactic intended especially to elicit peer pressure and thus regulate and promote computer use in schools. It was hoped that by having teachers reserve computer time, computer use would increase. On the other hand, believing that no one would check up on them and there would be no repercussions, initially teachers avoided reserving equipment to use in the labs, the classrooms, or their homes. All but one school, however, countered that behavior by posting reservation schedules outside the door of their computer lab. When the schedules were posted for all the faculty to see, the frequency with which teachers reserved equipment increased noticeably. Observing the success of the posting technique, a principal from a public school commented, "We had a schedule posted outside the lab door so that everyone could see who was signing in. And that's where peer pressure kicked in." A third-grade teacher from a nearby private school concurred, "Teachers began asking each other, 'Well, have you signed up for your computer time yet?' and now, people have become a lot more regular about signing up."

Teachers felt pressured to keep up with their peers in other ways as well. For example, peer group control was also instrumental in motivating teachers to experiment with particular software packages. One day, I was sitting in the teachers lounge of a public school when a teacher started talking about how much fun her class had in the computer lab that day. "The kids had the best time!" she exclaimed. She went on to describe the software, and it turned out that two others in the room had also had success with that program. They relayed their experiences with terms of color, excitement, and educational value. Truly, an advertisement could not have done better. Then several other teachers in the lounge, unfamiliar with the program, hesitantly asked questions. Finally, one of them shrugged and said, "Well, this sounds like another one I'm going to have to use." It seemed the teacher had not yet used the program but felt obligated to learn because other teachers used it. When I asked her about this episode later, she explained that often, when students in one class were introduced to a program that they liked and then talked about it at lunch or recess, students in other classes would then beg to "play the same games." That practice often made teachers feel as if they had to consider certain software if for no other reason than to keep up with their peers.

In his research on the government agency, Blau (1974) notes that competition existed among a portion of the staff. He found that exemplary behavior displayed by certain workers was erroneously associated with personal ambition by others. In fact, ambitious behavior was displayed by those workers with a greater competitive spirit. When one person became a pacesetter, others felt compelled to compete. Blau concluded that peer group competition stimulated worker performance.

Other Sources of Motivation

In addition to factors within schools that may have stimulated computer use among teachers, motivation was derived informally from other sources as well. Specifically, expectations regarding computing held by parents and professional norms held by teachers encouraged them to use computers.

Responsibility to Parents. Some teachers indicated that they were very conscious of a responsibility to community constituencies. These teachers commonly mentioned that they felt obligated to use computers because of expectations held by their school community, particularly parents. Teachers knew that parents, in large part, initiated and monetarily supported the computer program in their schools in anticipation that their children would use the equipment.

Parents, especially among the parochial and private schools, did not hesitate to actively demand some accountability concerning computer use from teachers. A fourth-grade teacher from a private school commented, "Parents insist that computers be used. In my 22 years of teaching, that has been the only thing a parent has ever insisted on, not math or English, only computer." A principal from a Catholic school reinforced this observation. She said, "Although I haven't gotten as many calls this year as I did in the last several years, they keep coming. Complaints are like this: 'Why is it that my child in fourth grade isn't using the computer as much as my second grader?' or 'Why did my kid's class miss computer this week?' " Teachers in the public system concurred. Although the incidents of parents actually calling them was not as great, they anticipated that parents probably "would say things" if the students did not go to the labs regularly.

Even though parental expectations persisted, teachers found them relatively easy to satisfy. Similar to administrators, parents tended to hold expectations focusing on quantitative rather than qualitative computer use. One fifth-grade teacher explained, "Parents assume that computers are useful but most of them are not computer-wise enough to know which activities are really profitable. They never ask how computers are being used. They just want to know that their kids are using them." Another teacher agreed. He said, "Everyone assumes that Johnny or Jill is getting enough computing because they go down to the lab on a regular basis and they can show their parents that they know how to turn the machine on. Parents seem satisfied and tend not to look beyond that point."

Principals and teachers were particularly interested in satisfying parental concerns over computer use perhaps because, in so doing, they reinforced the legitimacy of their school. As long as computers were used in schools to a degree consistent with community expectations, legitimacy of school activities could be realized. A teacher from a public school shared her observations regarding this matter:

> The parents are "wowed." I think parents see computing as a status thing about how good an education their kid is getting. For example we might use an interactive laser disk player sometimes in here and even though I'm just letting the kids browse through it because I don't know what the heck I'm doing yet, the parents are ridiculously impressed.

The principal from one parochial school reported an incident that sparked parental concern in his school and jeopardized legitimacy. A teacher administered a handwritten test to her children that then was graded and sent home with the students. It was to be signed by parents and returned to the school the next day. The principal said, "Several parents called or wrote comments on the test itself saying 'You've got all these computers. Why wasn't this test word processed?' And I think that's a wonderful question! Why not? It should have been!" Later in the conversation he added, "You can't ask your school families, your best source of money, for money if you're not going to show evidence that you're using the equipment you already have."

Schools answer to multiple external constraints (Bidwell, 1965; Hannaway, 1993; Lipsky, 1980) that include community-based concerns. Public expectations commonly are channeled through the voice of parents. *Voice* is a term used by Hannaway (1993); it refers to an "expression of interest, concern, or dissatisfaction by interested actors" (p. 149). Because of the immediate accessibility parents have to the teachers of their children, there is a certain primacy that parental concerns acquire. In a study examining the effects of external pressures on the distribution of influence in school districts, Hannaway (1993) found that parental influence had a positive effect on the extent to which teachers reportedly influenced school policy making. Hannaway's findings are consistent with mine in that teachers were especially responsive to parent expectations regarding computer use.

Responsibility to the Profession. Some teachers attributed their use of computers to a sense of professional responsibility, reporting that they felt obligated, as educators, to expose their students to computer technology. These teachers did not want their students to lag behind because of outdated or obsolete skills, and they commonly indicated that they thought computer experiences would impart important technological skills to students. For example, a fourth-grade parochial school teacher stated,

> I think everybody recognizes the importance of computers. All you have to do is go to the grocery store and you realize they're here to stay. So I think most teachers feel that knowing computers is an advancement for themselves and their students. It's something they need to know to con-

> tinue to remain strong in their field and it's something their kids need to know so they can be successful in the future.

More immediately, these teachers hoped to prepare their students with computer skills sufficient for success in the next grade. Teachers could only speculate as to what these skills would be, however, since curriculum guidance and overall program coordination was weak or nonexistent in each school. A second-grade teacher from the public system explained her views:

> If I didn't use it, say this year, I would feel more pressure from where my kids were going to go next year than I would be likely to feel from the administration. It would be the same feeling if I hadn't taught a part of the curriculum that my kids were going to be expected to know next year because they will go to their next year's class with a deficiency in this one area. I would feel like that responsibility would reflect back on me as a teacher.

Teachers frequently told me that, at a very fundamental level, they derived a great deal of personal satisfaction from providing students the opportunity to use computers because of the extent to which their students enjoyed computing activities. One teacher said, "It's fun for them. They enjoy it and that's exciting." For their part, students eagerly asked numerous times during the week, "Are we going to use the computer today?" I witnessed this time and time again when I visited schools. Kids, particularly in the lower grades, literally cheered when their teachers announced "computer time." One teacher from the public system said, "We have accepted computers and use them because the children enjoy it so. My feeling is the kids love it so we go down and we do it."

Some teachers, in fact, acknowledged that the only reason they familiarized themselves with computers at all was because of the pleasure children derived from computing activities. A third-grade teacher from a public school explained, "I don't think anyone in this school recognizes or cares whether or not we use computers except for the kids. We don't live in an area where most of our students have computers at home so it's a big deal for them. I love to take them down to the lab."

On the other hand, other teachers continued to find the presence of computers in their work environment disturbing and these individuals challenged the practicality and applicability of computing. One teacher from a private school voiced her concerns as follows:

> I really don't think that going down there and touching the computer for thirty to forty five minutes will enable people to be computer literate. Besides, what's the use? Does anybody who's caught up in this ever stop to think it's not a replacement for a human being? And all this hot software out there. I'm not sure if it's better than a good classroom discussion.

For this teacher and others who shared similar concerns, the issue of relevancy had never been fully resolved. They remained skeptical of the role of computing or the value of computer skills in elementary education.

There is one instance that deserves attention before concluding this chapter. Occasionally a teacher would use computers for reasons that had no obvious relation to organizational constraints. For example, one public school teacher who was particularly ambitious in her use of computers said that on coming to her school 4 years earlier, she knew nothing about computers. At that time, she noticed that although the computer lab was unused most of the time, it was the only room in the school that was air-conditioned. Her initial attraction to computers developed for the simple reason that, by using the computer lab, she and her students could conduct their classroom affairs and keep cool at the same time! Thus, her innovative behavior was driven primarily by individual concerns. Mavericks such as this teacher were few and far between. Nevertheless, they are significant to a study such as mine for two reasons. First, they illustrate the degree to which teachers could act on their professional autonomy. Second, they provide a continual reminder of the human element in social data.

Discussion

This chapter has examined the features of the school environment that encourage teachers to innovate with computers. Formal incentives to use computers, for the most part, were not available in elementary schools. Instead, teachers responded to multiple expectations that emerged informally. Within schools, these were derived from the leadership activities of both principals and computer champions, monitoring strategies, availability of equipment, and peer group pressure.

These informal motivational factors represent institutional constraints within schools that operate with implicit or indirect administrative support. They enabled principals to sustain a low profile and channel administrative influence more indirectly, thus reinforcing distance between teachers and administrators organizationally. Both administrators and teachers regarded computing as something to be negotiated. Each group, by protecting and trying to control its own position with respect to computer innovation, served to constrain the other group's influence and control. This process reinforced the occupational autonomy of teachers and simultaneously encouraged them to use computers. Lacking formal means of evaluation or reward, however, these factors alone were not strong enough to effect consistent change among faculty members.

Motivation to use computers also extended informally from a sense of responsibility that teachers felt toward school parents, the students, and to themselves. This successfully wielded a great amount of influence for teachers to innovate with computers and importantly, by satisfying parental expectations and other professional responsibilities, teachers derived intrinsic rewards from computing activities.

The dynamics surrounding the issue of motivation to innovate with computers suggest that no one factor exerted enough influence to assume primacy in the process of change and that motivation to use computers was not a well-defined, constant feature of the process of change in local elementary schools.

Because of the multiple sources of motivation that promoted computer use and the organizational context within which it was introduced, it would be reasonable to expect that the behavioral responses of teachers would vary widely as innovative expectations are negotiated and renegotiated. Whereas some teachers might embrace computing in response to motivational factors that they find particularly influential and rewarding, others, for whom these factors were less salient, may develop strategies that enable them effectively to mediate or avoid computing. This issue of computer use among teachers is addressed in Chapter 4.

4

Computing Styles Among Teachers

Despite the broadscale implementation of computers in elementary schools over the last decade, little is known about the ways that teachers have responded to this change. Because the success of computer implementation in schools depends largely on the efforts of teachers, it is important to investigate the strategies that teachers have developed as their schools continue to acquire computing equipment.

Contradictory arguments suggest that teachers will either embrace computing or resist it. It is likely that school decision makers anticipated that teachers would embrace computing because it is perceived to be advantageous to worker performance (Damanpour & Evan, 1984; Kraemer & King, 1986), and it has been associated with increased job satisfaction (Form & McMillen, 1983). Cohen (1987) predicted that computing would be successful in schools because of the flexibility of the equipment. On the other

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hand, studies of technological innovation in schools reveal that teaching routines typically remain stable in the face of technological change (Cohen, 1987; Cuban, 1986; Daft & Becker, 1978; Meyer, 1983). For example, in their review of public high schools located in the Chicago area, Daft and Becker (1978) discovered that even when schools adopted change, teachers often preserved more familiar teaching routines by simply disregarding or resisting it.

The examination of technological change in other occupations indicates that, rather than uniformly resisting or embracing new technology, workers respond with variability (Barley, 1988; Finlay, 1988; Joshi, 1991). On reviewing case studies of the implementation of computer systems into a variety of organizations, Joshi (1991) found that, depending on their own evaluation of technological change, users reacted to and defined the same change differently. Similarly, on the introduction of new technology in an industrial setting, some workers perceived and used it as a means to advance occupationally, whereas others did not (Finlay, 1988). This reinforces the notion that technological change in the workplace is an ongoing process of negotiation, and it suggests that discussions of change should consider how, relying on autonomy, "workers shape the deployment of the technology imposed on them" (Finlay, 1988, p. 21).

Autonomy is a fundamental ingredient of work. It enables workers to determine how their work will be performed and involves elements of decision making, scheduling, and pacing of work. With autonomy, workers may pursue diverse interests while actively engaged in workplace activities, thus addressing their individual workplace concerns on the job (Becker, 1970; Hodson, 1991a, 1992). Workers in semiprofessional occupations, including teaching, rely on their autonomy to establish work routines that satisfy their own needs as they respond to workplace demands such as technological change (Lipsky, 1980). They develop coping strategies that help them to define the technology in ways meaningful to them.

As coping strategies become routinized, they may have important consequences in the process of technological change, particularly in the ways that technology comes to be defined and used. For example, on the introduction of technological scanners in hospitals, Barley (1986) found that two occupational groups, radiologists and technologists, approached the new scanners differently, based on their respective professional autonomy, status, and technical expertise. Interpretations of the technology developed through work routines that were specific to the ways that the two groups used the scanners. Barley concluded that through the process of "cultural shaping," workers negotiate and define a technology's use in their workplace.

Given the high level of autonomy among teachers (Becker, 1970; Bidwell, 1965; Hanson, 1981; Lortie, 1975; Weick, 1976), it is not surprising that studies at both the national and local levels show that teachers demonstrate varying behaviors associated with computer technology, ranging from overt resistance to aggressive embracement (Becker, 1991; Evans-Andris, 1991; Kearsley & Lynch, 1992). Although some teachers continue to resist computing (Kearsley & Lynch, 1992), approximately 50% of the elementary school respondents on a national survey reported that computers should be used primarily for reinforcement of math and language skills, 30% reported they should be used as teaching tools, and 20% reported they should be used to teach about computers (Becker, 1991). Even so, Becker (1991) noted that actual use patterns differed from these views and the majority of teachers used computers routinely for fact reinforcement and enrichment, a pattern associated with low levels of staff development (Reinen & Plomp, 1993), leadership (Kearsley & Lynch, 1992; Wolf, 1993), and availability of equipment (Becker, 1991; Lieber & Cosden, 1989).

Clearly, teachers do not uniformly resist or embrace computers, but with few exceptions, our understanding of teachers' responses to computer technology in elementary schools is limited to their computer applications. It is likely that as schools acquire and promote the use of computers, teachers develop routines enabling them to address their own interests and concerns, as well as any computing objectives of the school. Through these everyday routines, teachers shape the ways that they use and apply computers. The process does not end there, however. As teachers define the technology through various behavioral routines, they create computing styles to which they informally subscribe.

Addressing the complexities of computer implementation in schools, this chapter goes beyond simple categorizations derived from survey data regarding computer applications to further conceptualize and identify computing styles among teachers. The questions then become (a) What strategies have teachers devised to manage change with computers on a day-to-day basis? (b) Through these strategies, how have teachers come to define the meaning of computers in relation to their jobs and to express various styles of computing? and (c) What is the durability of these computing styles over time?

Computers and Teaching

Among the teachers that I observed, there were two general orientations to computer technology. The majority of teachers tended to engage primarily in distancing routines, limiting their involvement with computers, whereas the remaining teachers tended to engage primarily in embracing routines, increasing their opportunities to use the equipment. Teachers expressed the orientations of distancing or embracing through a variety of strategies, and ultimately, from these, I identified two prominent computing styles—avoidance and integration—and a third, less evident style of technical specialization.

Two Orientations to Computing

This section demonstrates the general orientations of distancing and embracing by presenting two representative episodes of computing based on notes taken during field observations. These episodes illustrate the discretion that teachers exerted in the computing sessions and reflect the important differences, as well as similarities, in the teachers' orientations to computing. Although the episodes focus on the behavioral and perceptual responses of the teachers to computers, an underlying intent is to illustrate how, through those activities, teachers expressed their orientations to computing. In addition, these episodes exemplify many of the strategies characterizing what I came to recognize as the two most prominent computing styles in each school.

The first example, illustrating the orientation of distancing, describes Mrs. McGrath, a fourth-grade teacher from the public school system. She had been teaching for 21 years. She reported that she had used computers for 4 years and normally scheduled her class to use the computer lab once each week.

Example 1: Distancing

For three consecutive periods, more than a third of the public school day, the computer lab sat idle. At 2 o'clock, a full 10 minutes after the period had begun, Mrs. McGrath entered the room with 27 students. She appeared to be very sure of herself and seemed to have control of her class. In silence, the children found their seats at the terminals, turned them on, and waited for the computers to boot up.

Mrs. McGrath went to a file cabinet and began flipping through computer disks. After several minutes she made a selection and distributed a disk to each student. On insertion of the disks into the terminals, a math program appeared on the screens that focused on practice with fractions. It presented shaded portions of circles and instructed users to identify the correct fraction by filling in numbers for the numerator and denominator. Mrs. McGrath announced, "This is a game about fractions. If you know what to do get busy and otherwise raise your hand. Even though you haven't had this before, it is about numbers called numerators and denominators."

Once the class settled down to work on the program, Mrs. McGrath found a seat at the work table in the middle of the room and began grading papers. Occasionally students would ask questions. She appeared to find those interruptions rather exasperating and from her chair would

> answer in a sharp tone, "Pay attention to what the computer tells you to do."
>
> At one point a child raised her hand with a problem. She realized that she had selected the wrong number but hadn't pressed *enter* yet. She wanted to change her answer. Mrs. McGrath walked over to the girl's terminal and said, "I don't think you can change it. You'll have to think before you answer next time." While she was out of her seat, Mrs. McGrath circled the room to supervise the students' progress, and then went back to grading papers.
>
> At 2:30 p.m., 10 minutes before the period ended, Mrs. McGrath announced it was time to start leaving. As the children prepared to exit the lab, Mrs. McGrath smiled and said, "I'm glad we got to come today. Our field trip to the museum was postponed and the time before that it was something else."

The next example, illustrating an orientation of embracing, describes Mrs. Baker, a fifth-grade teacher from another school in the public system. She had been teaching for 18 years and had 3 years of experience using computers. Mrs. Baker scheduled her class to use the computer lab daily from 8:45 a.m. to 9:10 a.m., a full 15 minutes before school even began! The children came in early for independent computer work, depending on their bus schedules.

Example 2: Embracing

> Twenty students out of a class of 26 were already working at the computer screens by 8:50 a.m. As the students practiced their number skills on computer, Mrs. Baker roamed the lab, monitoring progress, offering suggestions, and teaching points individually to students that they may have found unclear. Simultaneously, she took attendance and conducted start-of-the-day classroom business. There was a high level of interaction among students and while they continued to work alone or together on computers, Mrs.

> Baker sat down at one monitor and worked momentarily herself. The printer produced a paper for her and by 9:15, the start of first period, class began.
>
> Mrs. Baker began to present a lesson in science. She reminded the students that they had copied the directions for the program in their science notebooks the previous day and she asked them to get out those instructions. The program involved a data set and instructed the students to scientifically test a "mystery matter," by computer, for its properties and possible identification. Worksheets accompanied the lesson, and the teacher told the students to hand those in to her before they returned to their regular classroom. Likewise, as students identified their mystery matter, they were instructed to ask their teacher to print out a computerized summary and picture of the matter on paper.
>
> While students worked, Mrs. Baker continuously monitored, gave individual instruction, and encouraged her students. When the bell rang for second period, the students packed up their belongings and left the lab.

The two episodes described above raise important issues regarding the ways that teachers approach computing. In both instances, the teachers provided opportunities for their students to use computers, but as the episodes reveal, their activities varied considerably. Mrs. McGrath came to the lab late and left early, spent lab time selecting and distributing programs, and graded papers while the students practiced drills on the computers. In all of these behaviors, she avoided meaningful interaction with the machine, yet provided her students access to the computers. In contrast, Mrs. Baker came to the lab early, encouraged students to use the computer not only to practice learning skills but also in conjunction with their science lesson, and directly used the equipment herself. Her behavior suggests that she incorporated computer experiences into her workday as well as that of the students.

Although these two episodes are representative of the activities that I most commonly observed in computer labs, it became apparent that teachers expressed their orientations to computing throughout their workday. Strategies related to computing as well as direct computing activities characterized the computing styles of teachers.

Strategies Related to Computing

Teachers exhibited distancing or embracing strategies by organizing their computer-related activities and those of their students before they ever engaged in computer applications. Noticeable differences in the data related to the reservation of equipment, schedule selection, and preparation of computer time.

Reservation of Equipment. Although not all schools started out this way, by the time I visited them, each school maintained a schedule of equipment use either on a weekly or a yearly basis that typically was posted near the entrance to the computer lab. Likewise, in most schools, if teachers did not already have a computer permanently stationed in their classroom, they could reserve and check out computer equipment for classroom use. Through reservation of equipment, a teacher could exhibit her intentions to use the computers and, by reviewing the schedule, teachers and others knew when the lab or other equipment was in use and also when it was available for extra use.

Though teachers seemed to reserve equipment regularly, a formal procedure for supervising the actual use of the equipment did not exist in any school. Teachers reported that, to their knowledge, no one monitored their computer use—neither their frequency nor patterns of use. Perhaps because of the lack of overt monitoring or supervision, the reservation of equipment did not ensure that teachers would use it. Instead, teachers relied on their own discretion in deciding whether to use computer equipment. For example, in one episode, I entered a lab and, wishing to verify the schedule that I had been given, asked a teacher in the lab if Mrs. St. George would be coming to the lab during the next class period. Shrugging her shoulders, the teacher responded, "Computer time around here is pretty sketchy. If Mrs. St. George's name is on the list outside, she'll be here if she decides to come."

In fact, there were numerous instances throughout the study in which I observed idle computers in labs or in classrooms even when they had been reserved, indicating that teachers may neglect to go to the lab at their designated time or refrain from using the equipment once it was in their rooms. Commenting on this pattern in her public school, a third-grade teacher said,

> Our principal made everyone take a time to go to the lab. I know that a lot of teachers don't use their time, though, because another third-grade teacher came to me halfway through the year and said, "I think she [the principal] is going to come down on us one of these days. I guess I need to be in the lab, but I have no idea what to teach these kids." And that was halfway through the year! She had not touched these computers for half the year!

A teacher in another school reinforced the notion that some teachers neglected to use their lab time. She said, "We are supposed to use the lab at least once a week, but there are still some teachers who don't go. In fact, I know a lot of people that schedule their once-a-week time religiously and then, half the time, don't use it."

Teachers typically appeared surprised when I noticed and asked about their absence in the lab and usually referred to their lack of time as an explanation. One teacher from a private school reasoned that "there's just not enough time in the day." A fourth-grade public school teacher added, "Our scheduling is not the best. I sign up to go to the lab but my days are pretty tight and we usually run out of time doing things in the classroom that we have to do." Unlike the others, one first-grade teacher from a public school confided, "I'm signed up to go [to the lab] every Wednesday morning but we haven't been in months. I think I can teach better than a computer can."

In several schools, teachers reduced the time they spent in the computer lab by exchanging computing responsibilities for other teaching activities. These teachers reserved computing equipment under their own names but, in reality, "traded off" their commitments when possible. A public school teacher explained,

> There are teachers here whose kids generally don't go to the lab unless somebody else takes them. Oh, they'll go themselves once in a while, but usually, they say something like, "I'll take your kids for Spanish this week if you'll take mine for Computer."

Principals also acknowledged that trading off occurred in their schools. The principal of a public school said,

> Teachers will say to each other, "If you take my children for an hour at the lab then I'll work with yours on something else. That kind of thing, trading off, goes on here. Teachers know who is really good at using computers and who feels comfortable with them and then they approach those teachers for trades.

Teachers commonly traded off computing activities in classrooms as well as in labs, particularly in instances when they had teaching assistants or parent volunteers who acted as "aides." Most often these assistants supervised and helped students with computing activities while teachers either worked with other students in math or reading groups or worked alone at their desk.

Unlike teachers who reduced the amount of time they spent with computers, there were a few teachers in each school who deliberately tried to increase their computing time. These teachers claimed they rarely, if ever, neglected to use the equipment during their reserved times. A fifth-grade teacher from a private school explained,

> At the beginning of the year I scheduled my class to go [to the lab] every week because, otherwise, I know what would happen. I would crowd computing out every time because there are other things that have to get done each day and we'd never get down there at all.

Likewise, there were occasions in each school that I noticed these same teachers taking their students to the lab or otherwise using the computer equipment even when they had not formally reserved it. A teacher from a public school stated, "I look for times I can use the computers more when we need them for something we're doing. If they're available, we just go down and use the lab." A third-grade teacher from another public school added, "If my kids are writing a story we'll just stay in the lab if the next teacher doesn't bring her class in. Most of the time that works out fine."

Clearly, reservation practices were an effective means of encouraging teachers to display an intent to use computers, but there was not necessarily a consistent relationship between reservation and actual computer use. The majority of teachers were diligent in reserving equipment but may have neglected to use it, whereas a few teachers in each school used the equipment even when it had not been reserved.

Selection of Schedules. In about half of the schools, lab schedules were predetermined by the technology committee or a lab manager. Even in those schools, however, there were numerous time slots throughout each day available for teachers to fill at their own discretion. When given a choice, teachers strategically selected certain times of the day and week to schedule the use of computers. Reservation schedules tended to be very full toward the end of the week, especially in the afternoons, with many vacancies in the schedules toward the beginning of the week, especially in the mornings. The popular scheduling times corresponded to those times when children commonly are most active and easily distracted and can benefit from hands-on activities. Likewise, if all of their regularly scheduled work was completed, those were times when teachers could easily accommodate extra activities such as computing.

The most favored scheduling times also coincided with the times and days in the school calendar that are most likely to be interrupted by field trips, holidays, special assemblies, play practices, and so forth. A lab assistant employed part-time in a parochial school commented that classes scheduled for Friday afternoon repeatedly missed their computer time for one reason or another. She said, "There is one first grade that actually only gets here about once a month instead of weekly because of so many special events. The little ones can't even remember my name when they see me, let alone anything about the computers." Similarly, a third-grade teacher from the public system explained, "Sometimes I miss computer time because I'm doing something else. For example, this past week we have missed computer because we've got to finish play practice."

School administrators commonly sanctioned special events, giving them precedence as they arose. These administrators indicated that they did not perceive computing to be an important activity in their schools, suggesting that for them, the issue of the relevancy of computers in elementary education had not yet been resolved. One principal admitted, "I don't mind teachers missing computer time for field trips. After all, it's not like the teachers have to accomplish anything specific in there [the lab]. It's more for fun and for practicing skills that the students have already learned." In one public school, interruptions appeared to be planned. The guidance counselor of that school reported that she deliberately scheduled sessions with entire classes or individual students during their computer time so as not to disrupt more basic classroom instruction. She said, "If I take them [the students] out during lab time, they won't miss anything important."

Unlike those teachers who selectively scheduled computing activities in time slots where they were likely to be usurped for other activities with a higher priority, a few teachers in each school scheduled computer time early in the school day. In interviews, these teachers reported that they usually coordinated computer time with their weekly lesson plans, reserving computers based on their curricular agenda, and they preferred early computer times so as to avoid or reduce interruptions. One second-grade teacher from a public school explained, "I like to use the computers to reinforce math skills. Since we always have math in the morning, I reserve the lab one morning a week so they can practice drills during math time." A fourth-grade teacher from another public school told me she usually signed up for the lab during her regular English time and added, "Right now we have been working on a journalism project and so there have been a couple of weeks when I have tried to get down [to the lab] at least two times or whenever we can because it is taking longer. We need that extra time." Thus by strategically scheduling computer time for their students, these teachers and others similar to them increased the likelihood of actual computer use.

The ways that teachers scheduled computer time reflected the ways that they used the equipment in relation to their teaching plans. It is likely that the teachers who selected the most popular times, such as the late afternoons or the end of the week, used that time as a buffer for their more regular classroom agenda. Observing this tendency in his private school, an administrator explained,

> I think most teachers in the lower grades look at morning time as the core time for teaching and they will protect it no matter what. And then they use afternoon activities, such as computing, simply as a "holding tank" until they can let the kids go at the end of the day.

A parochial school teacher observed,

> Computing is at the bottom of the list for most of us. It's something that the kids can do when they have time. But it certainly isn't anything that most of us incorporate into anything else we do.

If their schedules permitted, these teachers filled class time with computer activities. Their lesson plans did not suffer from schedule disruptions that prevented equipment use because computing activities were not integrated with the rest of their planned agenda.

The other teachers who scheduled computing at unpopular times were less likely to have that time interrupted. These teachers were able to use the equipment consistently in conjunction with their other, regularly planned classroom activities. One lab manager observed, "Those teachers realize the value of computers and schedule to use them at certain times within their curriculum. They are more aware of the potential of the labs so they include computing in their regular curriculum."

Preparation for Computer Time. The ability of teachers to use computers and computer time effectively depended, in part, on their efforts to prepare for that time as they would plan other lessons. Over half the teachers demonstrated little evidence to suggest that they prepared or anticipated the ways that computer time would be used. Most of these teachers reported that they tended to select the software they would use during their computer time in advance but that they frequently neglected to preview it. Others went to the lab altogether unprepared. One second-grade teacher from the public system explained, "I'll be honest with you. What I do is just go in with my class and say, 'Well, what haven't we done that you would like to do today?' " In one episode a teacher announced to her students, "If you don't like the program you're on, go back to the menu and choose something else. Just try to enjoy it."

Lack of lab preparation on the part of teachers suggested that they had no specific objectives for their students to achieve with computers. Reinforcing this impression, one teacher reported, "We just go down and decide what to do when we get there. I don't use it [computing] for any particular purpose so it doesn't matter." Lack of carefully prepared computer time also prevented teachers from providing their students with meaningful computer activities. I observed teachers who spent as much as a third of their total computer session selecting software that might be appropriate. A first-grade teacher admitted, "Sometimes, I spend their 45-minute computer time and haven't come up with anything that they can do. The software is either too hard or it is really for fifth grade instead of first."

In interviews, these teachers usually acknowledged their shortcomings regarding preparation, citing their lack of time as a reason. One teacher in the teachers lounge of a public school told me, "I think the biggest complaint about computers that everyone in this school has is trying to get the time to go in to preview and experiment with the new programs." Other teachers listening to our conversation agreed. Teachers occasionally indicated that lack of time was just one factor preventing them from better lab preparation. For example, a fourth-grade teacher from a private school reported, "There's just not any squeezing it into my schedule. I guess it just really depends on what your priorities are and how comfortable you feel. I suppose I could make the time and spend hours to have something prepared for my students to do, but I'm just not willing to do that."

Fewer than half the teachers I observed displayed evidence of carefully organized lesson planning that created time for important computer experiences for students. To maximize efficient use of lab time, some of these teachers commonly introduced lab activities in the classroom. For example, in the episode described earlier, Mrs. Baker's class had already recorded directions in their science notebooks during classroom time that readied the students for their computer activity in the lab. Similarly, a teacher from a private school explained, "Usually, I don't have time in the lab to explain what we're doing, so very often I do that in the classroom before we go to the lab." Another teacher noted, "It takes at least five minutes to get everyone settled on a program. If I spent ten more minutes explaining it there would be no time left to actually do anything." Likewise, these teachers frequently visited the labs to preview new software during their planning periods or before school.

In summary, the majority of teachers across schools developed strategies that reduced the actual amount of time per week they spent with computers, and enabled them to distance themselves from computers. Typically, these teachers scheduled computing inconsistently and used it as an itinerant activity. Their activities often resulted in computer time for students that was irregular, sporadic, and poorly planned. Other teachers in each school, however, developed strategies that increased the amount of time they spent with computers and enabled them to embrace the equipment. Their practices involving reservation, scheduling, and planning created the opportunity for computing activities to become part of their core curricular agenda each week.

Distancing strategies, such as the ones described in this section, prevented computer time from becoming an integral part of planned lessons. Teachers who engaged in distancing strategies used computer time as a buffer to their core curriculum. Lipsky (1980) argues that coping routines that workers develop commonly focus on the husbandry of resources. Excessive demands on the individual's workload result in attempts to secure or protect time. It can then be used as a resource or cushion against future excessive demands. In this case, teachers protected their normal work schedule through distancing strategies. Their planned curriculum and other activities, which usurped the time set aside for computers, provided these teachers with a legitimate alternative to computing.

Distancing strategies allowed teachers to appear as though they embraced computers when, in actuality, they increased the likelihood of temporarily excusing teachers from computing responsibilities. Teachers were aware of the appearances of others and yet continued to tolerate them. For example, a teacher in the parochial system told me, "I know one teacher who just turns on the monitor in her room but never uses the computer. Everyone walks by and seems pretty impressed that she's got the computer on." A teacher from a public school reported similar observations. She admitted, "You know, what we do is we stand out here in the hall or bus line and talk about what we have done with the computer when really, we haven't done anything."

Hodson (1991a) argues that appearance or image manipulation is an integral part of *making out,* a term that Burawoy (1979) uses to describe behavior in which workers simultaneously respond to organizational demands and individual concerns. Importantly, teachers who engaged in such behaviors did not overtly resist computing; rather, they exercised and reinforced their own discretion in the process of change, and addressed organizational objectives regarding computing on terms that they defined.

Computer Activities

Nationally, more than half of all activities with computers in elementary schools involve skill reinforcement through drill and tutorial instruction in math, language arts, or word processing (Becker, 1991). The use of software designed for these practices alone, however, does not indicate a teacher's orientation toward computing. This section examines distancing or embracing strategies employed by teachers as they used computers for instructional purposes. Noticeable differences in the data related to the behavior of teachers while their students used software designed for skill reinforcement or word processing and instructional projects teachers devised involving computer applications.

Drill and Practice and Word Processing. Nearly all of the teachers that I observed in computer labs used computers at the drill-and-practice level. Drill-and-practice software offered an appealing way of using computers that did not require intimate involvement, understanding, or participation on the part of the teacher. In fact, once they acquired basic operational skills, teachers only had to turn the machines on and call up the appropriate software or pass out diskettes for the students to use. Once the students learned how to turn the computer on, the computer software was, for the most part, self-guiding.

The majority of the teachers in the local schools used computers primarily or, in some cases, exclusively for drill and practice. For the most part, these teachers relied on the computers as surrogate teachers or tutors while their students used drill-and-practice software. A second-grade teacher at a private school reflected on the habits of many teachers:

> I basically use my computer time as remediation and reinforcement for whatever skills that I am teaching. This is just a backup for my students. Rather than having them do another worksheet, I send them to the computer and they get practice that way.

Repetitively using drill-and-practice software in her classroom computer, a third-grade teacher from the parochial system enthusiastically exclaimed, "This is something I don't have to learn. All I have to know is what numbers to put in there to get the right program. Then the kids can work on their own during their learning center."

While students worked independently on drill-and-practice programs in computer labs, teachers using the computers in this manner gained off-task time. With reference to her students, one teacher admitted, "I just plug them in. Then I can get my own work done." These teachers seemed to view that time as "their own" and protected it. One teacher in the public system noted, "Most teachers in this school go in [to the lab] and their common routine is to get the kids going and then they sit down and grade papers or work on something else they want to do." Similarly, a third-grade teacher from a private school revealed, "I don't stand around just watching them use a computer. I'm very often correcting something that I absolutely have to get back to them." Consistent with these teacher's comments, most of the teachers that I observed in labs sat and graded papers, planned lessons, or simply relaxed while their students worked on the computer practice drills.

Software designed for basic skill and fact reinforcement did not require an in-depth understanding on the part of the teacher. In fact, most of these teachers said they knew very little about the programs they chose for their students. Possibly as a result of their neglect to prepare for lab time, these teachers tended to select software with which they were already familiar or that they had heard other teachers talk about, and they tended to use the same software repeatedly throughout the year. For example, one day as I waited in a lab for a fifth-grade class to come for computing, a student entered the room to turn on the computers. I asked him if he knew what his class would be working on during their lab session. He replied, "I'm just guessing but probably 'Word Munchers.' That's what we always work on." In actuality, his class spent its entire session using that software. When asked about her use of drill-and-practice software one parochial school teacher admitted,

> I hate to keep doing the same things over and over again but I just don't have the time to go down there and sift through all of the disks. I just plug my students into the same math program each time we go. They kind of go at their own pace.

Observing a similar pattern in her public school another teacher complained with frustration,

> Let me tell you how most people use these computers, and it really upsets me. They have drill-and-practice games

> and those games, at least most of them, are probably 10 years old. I mean 7 years ago I was doing the same programs with my kids that I hear other kids talking about now. Things haven't changed.

Although there were no instances of these teachers using word processing with their students the first time I visited their schools, on returning 4 years later, I observed some of these teachers monitoring classes that were using word processing. For the most part, in these episodes, the students had handwritten the pieces to be word processed in their classroom and were transferring the piece to the computer, or they sat in the lab at a table and composed their piece on paper while other students who were further along used the computers. These pieces typically were not saved at the end of the sessions. The behavior of the teachers during these sessions was similar to that while students worked on drill-and-practice routines—that is, they helped the students get started and then did their own work at their desks.

Many of the teachers who used computers primarily for drill and practice or for word processing reported that because of their inexperience with the software, they commonly relied on the computerized instructions built into software programs to instruct the students. One teacher said, "I don't help the kids, although, if they need it, I'm right here. I guess I could figure it out if I absolutely had to." Speaking of others in her school, one teacher observed the following:

> Most teachers here never really sat through the games themselves. Somebody told them that this was a good game for math, let's say. Then they hope the child can boot up the machine and know what to do with it.

Similarly, in the episode described earlier, Mrs. McGrath could not explain the process of deleting and reentering an answer to her student, nor did she even try. Instead, she placed the burden on her student, implying that the error was math-related rather than one of technical understanding of the computer program.

In part, this was a face-saving technique that teachers commonly used. Because of the prevalence of home computers and computerized entertainment centers, it was not unlikely that students might have more general computing experience than their teachers. That notion intimidated teachers. One teacher summed up the feeling of others as follows:

> I've heard many teachers comment that "my kids know more than I do." That's kind of a scary thing that here are these little people and they know more than you do about what you're supposed to be teaching them.

Teachers frequently appeared to use the machines as scapegoats for their own ineptitude. If the machines did not function as the teachers expected them to, the malfunction was normally blamed on the "dumb machine" as opposed to their own lack of expertise. This face-saving strategy was a logical extension of the teacher's restricted understanding of the technology. Barley (1988) similarly found that technologists relied on their own processes of interpretation when unfamiliar technical problems occurred with technological scanners in hospitals. His data revealed that technologists constructed specific tactics to make sense of a technology of which they had only a limited understanding. Because their training focused on machine operation, they typically interpreted technical difficulties in mechanical rather than more substantive terms. My data and research such as Barley's demonstrate that workers who lack understanding of technical equipment will engage in a sense-making strategy that reinforces their dependency on the machines and, in turn, discourages them from gaining a more useful appreciation of computer applications.

Teachers who engaged in embracing strategies related to computing also applied computers at the drill-and-practice level and for word processing, but the behaviors exhibited by these teachers while their students worked on the computers distinguished them from other teachers. For example, in the episode described earlier, Mrs. Baker encouraged her students to sharpen their own individual skills with drill-and-practice applications.

During that time, however, she roamed the lab and instructed students individually. Similarly, a third-grade teacher from a public school explained, "Most of the time I go around and watch to see what the students are doing. Occasionally, I'll sit down and succumb to the urge to play the games with them, but for the most part, I'm walking around." When students of these teachers used word processing, they often composed their pieces on the screen rather than copying pieces they had already written. They usually saved their pieces from one computing session to the next so they could continue on with the same piece to completion rather than begin anew each session. On completion, these students often printed their pieces with little or no help from their teachers.

As students worked independently with computers, these teachers used that time to monitor students' progress on the software, and interaction between the teacher and student was instructionally focused. One exception to this was when these teachers used that opportunity to complete other tasks that could be accomplished only in the lab, such as printing, previewing software, and so forth. When teachers used computer time in this way they were able to assess students' progress, complete tasks efficiently, and also increase their familiarity and experience with the computers.

These same teachers reported that they introduced their students to a variety of software throughout the year. The frequency of my observations in which teachers introduced unfamiliar software to their students while conducting lab sessions verified these reports. During one such session, the teacher introduced new software by demonstrating it on an overhead projector. As she lectured, the students performed the appropriate functions on their individual keyboards. After the session this teacher explained, "If this goes well we might use the same package next week before we go on to something else."

Instructional Projects Involving Computer Applications. Whereas there were only isolated instances in which teachers, engaging in distancing strategies, used software for purposes other than drill and fact reinforcement or word processing, teachers engaging in embracing strategies relating to computing often incorporated computers as a teaching tool, to enhance learning units or other educational activities. A fourth-grade teacher from a public school explained,

> We do a tiny bit of drill and practice. But really, almost anytime I use a program, I want the kids to get to the point where they can think independently and creatively and use the computer as a tool.

Using the computer as a tool involved the deliberate integration of computing with classroom curriculum and often emphasized the way that software was applied more than the selection of software itself. For example, although I frequently observed students using a popular geography gamelike program that gave them clues and required them to determine the geographical location of a missing subject, I witnessed one episode in which, using the computer as a teaching tool, the teacher grouped the students into teams of four, provided them with maps, globes, and travel guides, and encouraged them to explore those resources as they used the program. She told me later that, through that lab session, her students had been exposed to a lesson in social studies, computing, and cooperative learning. In another instance, a second-grade teacher from the parochial system had her religion class use a software program containing scriptural readings, discussion questions, and activities pertaining to the issue of forgiveness in preparation for receiving the Sacrament of Reconciliation. Likewise, book reports or English essays were commonly developed and edited by word processor or illustrated with computer graphics. Many times, students then organized and kept these works in writing portfolios.

Several of these teachers reinforced the use of computers as tools by occasionally having their classes produce intriguing projects with the computer. One public school teacher, for example, guided her fifth-grade class in creating a school yearbook by computer. The students developed a database that contained descriptive information on every student who was to be included in the book. Similar to the multifaceted social studies lesson described earlier, through this project, the class gained experience in journalism, data collection, and computer technology. Toward the end of a school year, a teacher in another public school reinforced computer applications for visual arts by providing her students with the software, materials, and guidance to design their own logos on computer and transfer them to T-shirts. A teacher in another school, conducting a social studies project on local culture, used the computers in a similar way, whereby her students designed quilt patterns on the computer and then later, using those as a guide, stitched real quilt blocks.

Not all teachers engaging in embracing strategies used the computer to integrate classroom and computing activities. A few teachers used the computer as the focus of their lessons during computer time, and in fact, typically spent more time teaching about computers than teaching with them. Most often, they presented lectures that concentrated on concepts and activities such as flowcharting and internal computer operations, which more commonly are found in computer science courses. One of these teachers justified his approach by saying, "Other computer activities are not as valuable to students until they have an appreciation for the internal operation of the machines they operate."

Along with other parts of the computer, these teachers also spent a noticeable portion of computer time teaching about keyboarding or having their students practice it. For example, these teachers commonly had their students work on word processing to gain and practice keyboarding skills rather than develop their writing techniques. One teacher explained, "The keyboard provides basic access to everything else on a computer. I don't think kids can advance on computers until they know the keyboard." Referring to a teacher such as this in her public school, a respondent reported,

> Yeah, he taught them all the parts of the computer and keyboard and all the methods of programming, and now those kids program their little hearts out. But they really don't get to enjoy the computer. That's just not my philosophy of teaching with computers.

Computing Styles

The computing styles of avoidance, integration, and technical specialization identified in this section are based on the most prominent and recurring computer-related behaviors among the teachers whom I observed in local elementary schools. Though the teachers may not exhibit every element of what came to be recognized as characteristic of a particular computing style, and in some instances engaged in inconsistent or contradictory behaviors, for the most part, teachers manifest computing styles through everyday behaviors reflecting distancing or embracing strategies.

Of the 72 teachers I observed conducting sessions in which they used computers during the first phase of this study, approximately 60% demonstrated the computing style of avoidance, 28% demonstrated integration, and 8% demonstrated technical specialization. Four percent (three teachers) did not exhibit behaviors consistent with any one computing style. Although the specific breakdown varied slightly from school to school, this distribution was fairly consistent throughout all the schools participating in the study, despite any structural variations relating to the public, parochial, and private school settings. This consistency in distribution is more than likely a reflection of the similarities that schools shared in the ways that they implemented computers.

Avoidance

The predominant computing style in each school was one in which teachers provided students access to computers but, for the most part, did not use the equipment themselves. Clearly, teachers adhering to this computing style created and engaged in a cluster of distancing strategies that supported that notion. They did not prepare for consistent or effective use of computing time and scheduled it at times that increased the likelihood of disruptions. Their students used software in routine ways lacking creative input or involvement on the part of the teacher.

When teachers planned for and used computing as an itinerant activity, their understanding of the technology would not increase nor its applications vary. Rather than teaching students with computers, they taught students how to operate machines. Their behaviors insulated their more established teaching patterns. They provided and facilitated opportunities, however, for potentially important technology-related experiences for their students. Teachers who engaged primarily in distancing behaviors expressed a computing style that I label *avoidance*.

Integration

Unlike their counterparts who avoided computing, other teachers in each school engaged in a less prominent computing style in which they embraced computers and devoted many hours experimenting with the equipment and mastering it. These teachers organized their computer-related activities in ways that promoted consistent and effective use of computer time and increased the likelihood that the technology would be used as a teaching tool. They assisted their students as they used computers for skill reinforcement and writing development, and they also devised nonroutine software applications that enhanced lesson plans and motivated students. Teachers integrated computer technology into weekly lesson plans, into their work routines, and into the learning experiences of students. I label the computing style of teachers who engaged in these embracing strategies *integration*.

Technical Specialization

Because of their computer-related practices, the computing style of a few teachers could not be identified readily as avoidance or integrative. In several instances, these teachers did not engage in behaviors that characterized either computing style, or they engaged in routines that characterized both styles. One computing style in particular, which I call *technical specialization*, was easily confused with integration at first glance. Teachers practicing this style possessed computer skills that were noticeably strong. They carefully scheduled and prepared computer time in advance. They used computers at various levels and in a variety of ways, including record keeping, skill assessment, and so forth. Use of computer time distinguished the style of these users from integration. These teachers spent more time teaching about computers than teaching with computers. Unlike integrators, they presented computer lessons in the context of a distinct and separate curriculum that seemed unrelated to the rest of the curriculum that they taught. The attitude toward lab time and computer activities held by these teachers also distinguished their style from integration. It was very sober and intense. This was in sharp contrast to most other users who viewed computer activities more lightly, to the point of being gamelike in many cases.

The attitude of these teachers, coupled with their typical computing activities, caused them to struggle to sustain a respectable level of interest in computer technology among their students. In actuality, they often failed. For example, I observed one teacher present a lesson on flowcharting. He passed out worksheets and began to lecture. Most students listened attentively for a few minutes and then started doodling. One boy looked at the worksheet and said sarcastically, "Oh, this is just so hard." Another child asked permission to go to the bathroom and did not return for 15 minutes. Others began to whisper back and forth and pass notes to each other. As they left the lab at the end of the session, one student said, "I hate computer." Others agreed. The boredom and disinterest among students I observed during this lab session and others similar to it was common only during occasions when lab time was devoted to activities that students perceived as being unrelated to regular classroom work.

The Routinization of Computing Styles

The presence of different computing styles among teachers in schools raises important questions regarding their consistency and durability. It seemed plausible that as teachers gained familiarity, experience, and additional training with computing, they would be inclined to use computers in ways that demonstrated stronger styles of computing or more effective strategies of teaching. There were, however, only isolated instances of teachers changing styles of computing from the time that I first met them until the time that I revisited their schools 4 years later, suggesting that computing styles become routinized over time.

With few exceptions, avoiders remained avoiders despite increased familiarity and additional training with computing equipment. Although these users expanded their machine skills to include limited use of newer equipment such as printers and laptops during that time, for the most part they still continued to distance themselves from the equipment and otherwise engage in strategies of avoidance. One exception to this pattern was a public school teacher who switched from the computing style of avoidance to integration. Since our earlier interview, she had begun coursework for administration supervision certification and had taken a computer course required for that certification. In addition, she had left classroom teaching to become a reading specialist. She reported that she presently used computers individually and in the lab with her reading students, and she also used it to assist her in her role as the secretary for the PTA board.

> My laptop is helpful with what I do now because sometimes I want to work with students one-to-one in a quiet setting. We have a little bit more privacy to talk. I also have the children use them for word processing. For instance, we just finished a mystery story and afterwards, I asked the children to express how they would end the story differently on computer. It gave them a chance to be a little bit more creative and they enjoyed it. Also, I schedule them to the lab maybe once every two weeks usually to help them with their skills. It just depends on what they are working on.

Whereas this teacher previously had engaged in a style of avoidance, this statement indicated that she had begun using computers in ways more characteristic of integration.

Nearly all of the individuals who initially demonstrated integration or technical specialization continued to engage in strategies characterizing these styles of computing when I revisited their schools. An exception to this involved a few teachers who initially had engaged in integration but switched styles to avoidance. For example, during my first visit to her school, the computing behavior of a second-grade teacher working in the public schools suggested that she was an integrator. During observations on my return to her school, however, her behavior suggested that she had switched from integration to avoidance in the 4-year period.

This teacher no longer went to her school's computer lab with her students on a regular basis, nor did they use computers in the classroom. Even though this teacher revealed that she used a computer at home for administrative tasks such as record keeping, she reported that computing activities ranked lowest on her list of priorities for her classroom and that she deliberately had begun avoiding computing activities altogether at school about 2 years earlier. She said, "I don't ever go to the lab anymore."

The teacher attributed her reduction of interest, expertise, and use of computers to time constraints and the computer assistance provided in her school by a newly hired computer coordinator. She said that she and the other teachers in her school felt as if they had so much to do that they could not "think about anybody else or do anything else." Then she added, "Since the computer lab teacher became official, I just send the kids in there with her and I don't go at all." After a moment she added, "I really don't want to get involved with her [the computer teacher's] job." A first-grade teacher in the parochial system demonstrated a similar pattern of style switching for similar reasons. Whereas in the earlier phase of the study she had showed signs characteristic of integration, she reported that she had not increased her computing skills since that time, and, in fact, she had probably experienced an overall decline in computing strategies, skills, and applications. She attributed her regression to her lack of time, particularly since she had become assistant principal, and to the fact that she now relinquished all of her computing responsibilities to her school's computer coordinator.

Discussion

Teachers exert their autonomy and discretion when responding to technical change in elementary schools. The evidence presented in this chapter reveals that teachers in local schools responded to the broadscale introduction of computers into their workworld by developing informal computing styles in the process of change. Various computer applications, such as those identified by a national survey (Becker, 1991) represent, in fact, a culmination of multiple strategies devised by teachers in their attempt to define technical change.

Most of the teachers in this study did not overtly embrace or resist computer implementation but, instead, responded to computing as an undervalued activity, treating it as something itinerant or peripheral to their task of teaching. The avoidance strategies that these teachers developed became an acceptable, established computing style in the schools, allowing teachers to evade meaningful interaction with the equipment while providing computing experiences for students. Other teachers embraced the technology and developed an integrative style of computing, using computers as an important, integral teaching tool. They applied the technology in creative ways that enhanced classroom lessons and, most likely, strengthened their teaching skills and championed the idea of computer technology in their schools. A few teachers engaged in technical specialization, whereby they devoted much of their effort promoting the technical aspects of computers among their students, but teachers engaging in this style of computing generally failed to use the computers in ways that demonstrated relevancy to students.

An understanding of the computing styles through which teachers express their orientations to computers can contribute to an emerging body of literature that views the workplace as a social setting within which workers devise various ways to assert autonomy in their jobs. Hodson (1991a) argues that autonomous workplace behaviors that develop as workers attend simultaneously to their own concerns and organizational demands generally center around either enthusiastic compliance or conditional effort. Workers who enthusiastically comply typically promote the achievement of goals defined by the organization, whereas workers who give effort conditionally protect their own workplace concerns as a first priority and may or may not promote organizational goals. Their behavior often is characterized by footdragging, appearance management, and gossiping. Only in extreme cases might their behavior include overt resistance and deliberate attempts to undermine organizational goals.

The computing styles of teachers demonstrate both conditional effort and enthusiastic compliance. Avoidance strategies included the insulation of teachers and their typical teaching routines from the technology when possible rather than overt resistance of computer technology. These strategies were marked with appearance management and portrayed an image of compliance, when, in fact, the behavior was often marked with contradictions and discrepancies. On the other hand, the styles of both integration and technical specialization illustrated enthusiastic compliance. Furthermore, through the reinforcement of their classroom curriculum and use of computers as an important teaching tool as well as to improve their own efficiency, integrators demonstrated strong technology leadership skills (see Collis, 1988). Teachers possessing such skills may go a long way toward fostering an atmosphere in their schools that is receptive to technical change (Kearsley & Lynch, 1992).

Computing styles of teachers remained fairly consistent over time. The routinization of computing styles is an issue that is pertinent especially for those schools that have introduced computers and wish to encourage a particular style of computing, such as integration, among teachers. It is also an issue that has relevancy for teachers who, for whatever reasons, may wish to break from one style of computing to engage in another. Whereas this chapter does not consider the impacts of computers on the occupational skills of teachers, it is likely that different computing styles create barriers or opportunities for skill enhancement, thus reinforcing the computing styles to which teachers subscribe. This issue is taken up in Chapter 5.

5

Considering the Effects of Computing on Teaching

Changes in technology typically disrupt conditions of work such as job skills and work roles, yet in their continued effort to acquire and implement computers in schools, educators have neglected to consider the effects of this technology on the work of teachers. As teachers in elementary schools engage in various styles of computing, including avoidance, integration, and technical specialization, they may experience consequences of computers relating to those styles. Therefore, even within the same school, the effects of the technology may not be similar from teacher to teacher. Moreover, as the positive and negative effects of computers gain salience among the teachers, they accordingly may sustain computing behaviors consistent with the styles to which they identify.

Although few studies have examined computers and teaching specifically, the effects of technology on work in other occupations have been debated extensively in sociological literature. Much of the research predicts that new technology will have a direct, uniform effect, either negative or positive, on job skill requirements and other conditions of work (Adler, 1986; Attewell, 1987; Braverman, 1974). Proponents of the downgrading thesis argue that the quality of work-required skills, training, and task complexity decreases as new technology is introduced. In a study of the computer industry itself, Kraft (1977) found that the technology required task specialization and reduced the general skills of each worker. Computing decreased the need for creative, mental activities and increased routine, manual performance of tasks. Glenn and Feldberg (1979) reported similar findings in their examination of the effects of new technology, including computers, on clerical work. Computers simplified, mechanized, and otherwise downgraded the skills of clerical workers.

In contrast to the downgrading thesis, upgrading arguments suggest that jobs evolve along lines of greater differentiation and efficiency on the introduction of technological innovation. A study of computers in the banking industry conducted by Adler (1986) revealed that the technology required higher average skills, training, and specialization of middle-level banking personnel. In addition, computers enhanced job quality by increasing levels of responsibility and knowledge necessary to operate new machinery (Adler, 1986).

A more comprehensive explanation of the "skilling" debate suggests that the effects of new technology on the conditions of work are contingent largely on social and cultural elements within the organization or occupation that are independent of the technology itself (Attewell, 1987; Barley, 1988; Kelley, 1990; Rumberger, 1988). The contingency model identifies the presence of intervening variables in the process of technological change and indicates that depending on the ways that it is used by workers, new technology offers workers important access to skill enhancement (Barley, 1986; Disprete, 1988; Finlay, 1988) or skill downgrading.

Hall and Hord (1987) argue that upon the introduction of change in schools, teachers develop *concerns,* a term used to designate personal feelings, preoccupations, and anxieties attributed to a particular issue, task, or demand. They argue that, left unattended, these concerns may affect the ways in which teachers perceive and use an innovation such as computers. The authors conclude that documentation and consideration of teachers' concerns regarding the effects of new technology will enable managers of change to develop strategies that reduce negative effects and capitalize on those that are positive as they continue to promote technical change in their schools.

This chapter considers the effects of computer technology for teachers and their jobs. As teachers use computers, traditional features of their work and job skills are vulnerable to disruption. What are the outcomes of computing on the work culture of teachers? In the following sections, I examine the positive and negative effects of computing as they relate to the computing styles of teachers.

Avoidance and Effects of Computers

A prominent style of computing among educators in local schools was that of avoidance. Avoidance enabled teachers to provide students access to computing opportunities, usually drill and practice or word processing, but at the same time distance themselves from the equipment. As teachers employed computers in this way, they developed concerns relating to machine skilling, risk taking, and task displacement.

Machine Skilling

The use of computers in school labs and classrooms requires that teachers gain, at the very least, rudimentary machine-related skills. Teachers learn the basic principles of machine operation to devise computer applications for their students. Normally, teachers in local schools acquired these mechanical skills through formal group training sessions and more informally through peer tutoring.

Although over time additional training and practice may enable many teachers engaging in avoidance strategies to become quite adept at facilitating computer applications for their students, they typically did not seem to value their mechanical skills. One teacher recollected, "In the beginning, I was fascinated by computers. I thought they really would be beneficial. All I've learned though is how to operate a machine. I can't remember why I was so enthused."

These teachers did not perceive their mechanical skills to be relevant to their jobs. For example, one fifth-grade teacher admitted, "I would feel inferior if I didn't know anything about computers. Instead, I feel good that I do know how to use them. But, I don't feel like it makes me a better teacher, though." Other teachers agreed. One said, "Operating the computer doesn't make me a better teacher, it just makes what I teach more fun for the kids. I really don't think the means justify the ends." Another respondent voiced a comparable opinion, "My skills on the computer have gotten better, but not my teaching skills."

Although for the most part, these teachers agreed that their mechanical skills improved over time as they operated computing equipment, they distinguished those skills from other teaching skills and did not recognize them as relevant to their job of teaching.

Risk Taking

Any skill enhancement that teachers engaging in avoidance strategies may have gained as they acquired and developed mechanical skills was offset as computing compromised underlying skills that these teachers found more pertinent to their jobs. Although computing promises to improve teacher productivity (Trollip & Alessi, 1988), teachers reported that until they became familiar with the technology and related software, teaching with computers was unavoidably less efficient and hence less productive than teaching without them. Moreover, because of the ongoing acquisition of new equipment and software, this was a recurrent problem.

Teachers hesitated to jeopardize the security of their consistent level of classroom performance to introduce unfamiliar computer materials and methods into their teaching routines. A third-grade parochial school teacher stated, "You know you can teach it well another way, but when you use computers, you're taking risks." A teacher from the public system concurred. She admitted that she would like to begin using the newer equipment her school had recently acquired but she was reluctant to do so. She explained, "I feel like I'm going out on a limb. I don't know whether to take the risk or stay secure."

Teachers also risked effectiveness when they applied computing in their teaching routines. Whether they were ineffective in actuality, I frequently observed teachers present computer-related lessons that they considered to be ineffective. The following episode, taken from field notes, is an example of one such lesson. A fifth-grade teacher had presented a math class on fractions earlier in the week. She hoped to use computer software to reinforce mathematical concepts that she had already introduced in the classroom.

> The class of 17 students entered the lab at 1:40 p.m. Mrs. Johnson passed out the disks containing a math program, all the while explaining it to the students. Before she could get back to her seat students bombarded her with questions. "What does 'reduced' mean?" "What is a mixed number?" "What is proper and improper?" For several moments, Mrs. Johnson attempted to address the questions.
>
> At 1:55, appearing quite flustered and embarrassed, Mrs. Johnson collected the disks and distributed others saying, "This is another fraction package." By now, the noise and commotion among the students had increased noticeably. This time questions from students stemmed not from the terminology used in the software but from poorly written instructions. The students seemed quite confused and most of them became boisterous. Abruptly terminating the session, Mrs. Johnson told the students to turn off the machines and return to their classroom.

The episode described above illustrates the risks that teachers commonly faced when they used computer software with their students. Mrs. Johnson wanted to devote her computer time to reinforce certain math concepts. In fact, the time spent in the lab resulted in further puzzlement and misunderstanding for the students because of the unfamiliar terminology presented in the software. Moreover, the teacher appeared quite embarrassed when she realized the software package had been a poor choice on her part, and she was unable to cope with the commotion that erupted.

Mrs. Johnson later reported to me that she believed she had failed in her attempts to introduce the software package. She considered the lesson to be extremely ineffective because instead of reinforcing math concepts, the session increased confusion. Mrs. Johnson admitted that she had neglected to preview the software material, a task that teachers frequently neglected to do, citing their lack of time as a reason, and as a result, she had not anticipated such a "disaster." She said, "Computers frustrate me. They make me feel like a less successful teacher because I don't like the fact that I don't accomplish what I felt like I wanted to when I use them." Rather than indicating that she would begin previewing software in the future so as to avoid situations such as this one, Mrs. Johnson said she probably would not use that particular software again.

In many instances, teachers reported that they suspected that computers impaired classroom effectiveness when, in fact, it may not have been impaired at all. This discrepancy more than likely stemmed from the teachers' insecurities regarding computer use. On the other hand, Mrs Johnson attempted to enhance her lesson by employing computer software and experienced the opposite. In either case, it is probable that the ineffectiveness and embarrassment that teachers anticipated or actually encountered dampened their enthusiasm and confidence, and in turn, it reduced their subsequent use of computer technology.

Task Displacement

When technology is used to perform specific tasks formerly assumed by the worker, workers experience task displacement. The technology displaces tasks that are integral to the job and the new tasks required of the worker pertain to machine operation. Thompson (1983) argues that when this occurs, workers' previously existing skills become secondary in importance to the smooth mechanical functioning of the machine.

As teachers used computer software to introduce or reinforce basic learning concepts as Mrs. Johnson did in her math session, students tended to fix their attention on the computer and depended on their teachers more as machine facilitators rather than instructors. In those instances, they relied on their teachers to answer questions regarding machine operation or for clarification regarding software features. This, in turn, elicited a sense of task displacement among teachers. One teacher complained, "The kids get to the same spot in the program at different times. So you answer the same question over and over again as each child comes to it." Except for questions of this nature, however, interaction between the teacher and student was minimal.

Software designed for drill and practice or word processing may create ample opportunity for teachers to devote more time instructing students individually or improving their own computer skills. Teachers engaging in avoidance strategies, however, typically opted to use the time either to complete tasks that they perceived as more immediate to role of teacher, such as grading papers or lesson planning, or simply to take a respite from their busy teaching routines. Inadvertently then, teachers reinforced their role as a machine facilitator and suffered task displacement as a consequence.

Task displacement was a serious concern voiced by many of these teachers. They reported feeling "underused," "out of control," and having "reduced responsibility." One fourth-grade teacher made the following complaint:

> Instead of a teacher, I feel like a mechanic, and a poor one at that! If someone's screen doesn't come up or if somebody shoves their diskette in too far, I am supposed to fix it, but really, I have absolutely no idea how to. That's been so frustrating.

Indeed, I frequently observed sessions in which teachers devoted a great deal of their time coping with mechanical or technical problems at the expense of more substantive instruction. Such instances occurred both in the labs and in the classrooms. For example, one afternoon during a lab session involving a class of third graders the teacher announced, "I'm going to pass out a disk on math and then I'll come around to each of you to see if you need help getting started before I sit down." Moments later, a boy raised his hand and said, "I think my computer is broken." In fact, the computer was not broken but the screen needed to be cleared for the program to begin. The teacher left a child to whom she was speaking to go help the boy. She examined the screen and pressed a key. Assuming she had solved the problem she moved on, this time returning to her desk rather than to other students. Soon afterward, another boy, experiencing the same problem as the first one, called to the teacher, "My program doesn't work," whereby the first boy chimed in, "Mine doesn't either." The teacher repeatedly hit one key on the second boy's computer but the screen did not clear and the program did not begin. Appearing quite frustrated, the teacher moved both boys to new computers, told them to begin again, and returned to her desk. Later this teacher voiced her concerns to me, "Computers interfere with the human element of teaching. Teaching should be a humanistic profession, not a mechanized one."

Another episode occurred in a classroom where a couple of second graders worked at a computer in the back of the room while their classmates were either having a reading session with their teacher or doing "seatwork" at their desks. The computer jammed and the children sitting at the machine began waving their hands wildly in the air until they captured their teacher's attention. One child said, "Mrs. Romano, the computer broke." The other two children nodded their heads, one of them saying, "Yeah, the computer's broke. We need you to fix it." Mrs. Romano left her reading group and hurried to the computer to attend to the problem. On returning to the reading group, she spent several moments collecting her thoughts and reorienting herself to the group before she began teaching again. Later, during an interview, Mrs. Romano explained,

> If I'm in the middle of a reading group and I have to stop and go fix the machine I get really irritated because we

> have so much material to cover anyway, and reading is so important. When I have to stop a reading group to do something on the computer, that's really frustrating.

Mrs. Romano's experiences and comments raise two important issues. First, they indicate that she resented the computer because of the interruptions it created during time that she devoted to other instructional activities. Second, they suggest that she prioritized other instructional activities over computing. Comments from other teachers revealed that they too resented the computer for similar reasons, particularly the time that computing detracted from other activities. For example, one teacher complained, "It's so frustrating because it takes valuable time away from teaching to explain how to use the computer or fix it when really, they are just playing games, you know."

As task displacement occurred, the special instructional skills and knowledge of teachers became underused, which resulted in resentment of computer technology among these teachers. Kraft (1977) reported comparable findings in his examination of computer programmers. The production of "canned" software programs increased the division between mental and manual routine tasks. He concluded that reliance on software programs for tasks previously assumed by workers contributed to the deskilling and routinization of tasks. Similarly, as teachers sacrificed instructional tasks to facilitate their students' use of computers, particularly drill-and-practice software, the necessary mechanical tasks that remained became less interesting and less appealing.

Research regarding skilling issues commonly ignores the technical and social factors that define the context within which the technology is used. Skills that are gained or lost must be assessed in terms of their integral meaning to the job. Barley (1988) notes, for example, that the skilling literature typically cites automated history taking, conducted by physicians, to exemplify the downgrading thesis. That activity, however, is peripheral to the integral skills of physicians. Barley argues that only those tasks that define the core skills of the worker should be considered as compelling evidence for skilling arguments. Thus, even though teachers engaging in avoidance gained mechanical skills as they learned to use computers, they jeopardized other skills and qualities of their jobs, such as effectiveness, classroom control, and security, which they regarded as more meaningful and fundamental to their work as teachers.

Integration, Technical Specialization, and the Consequences of Computers

Teachers who engaged in a style of computing marked with integration or technical specialization generally demonstrated a wider range of mechanical skills and variety of computer applications. In addition, many of these individuals promoted the idea of computing in their schools by fulfilling managerial or tutorial tasks. Computers affected the work of these teachers both positively and negatively. When they used the computer for instructional purposes, it reinforced and enriched their teaching skills. Early on, however, they assumed responsibility for necessary operational tasks pertaining to computers, many of which they perceived to be a reduction in quality compared to other instructional tasks.

Tool Skilling

The teachers in local schools who demonstrated strategies of integration or technical specialization used computers primarily as a teaching tool or as an object of teaching respectively. In either case, these teachers indicated that computers enhanced their own teaching skills as well as student learning. Specifically, these teachers valued computers because the equipment enabled them to create opportunities for new learning projects involving computers, to assess and evaluate students' skills, and to individualize instruction.

When teachers used computers as a teaching resource, they often noted that cooperative computing activities brought excitement and vitality to the teaching and learning experience. A fifth-grade teacher reported that she used word processing to teach students how to write their papers and then applied those skills to new projects. She explained, "We used the word processor to produce a newspaper. I had never done that, so it's been a real learning thing for me. I've learned as much as they have. It's been really interesting and we've all gotten so enthusiastic about it!" A third-grade teacher at a private school shared her enthusiasm:

> I use games on the computers that kids can work on in groups. They [the games] really get the kids' minds to stretch and to think of alternative possibilities for solutions. The kids have to consider many factors, eliminate the uncertainties, and pull in the ones that they think might work. I just love what a computer can do for the kids, and me too! It has reinvigorated me as a teacher.

The benefits of the computer as a skill assessment tool appealed to teachers engaging in styles of integration or technical specialization. As described in Chapter 4, these teachers commonly monitored their students progress as they worked independently on drill-and-practice routines, word processing, or other computer applications. The teachers observed students to determine whether they were having problems and, more specifically, what those problem areas were. A second-grade teacher commented, "While I watch kids do drill-and-practice on the computer screen I can locate problem areas with students who might be having problems with a certain skill." Another teacher elaborated, "The computer gives me a chance to look at the kids' individual learning patterns. It gives me a chance to see what they may be having trouble with whereby, if we're working as a large group in the classroom, this is not possible." Whether in reading, math, grammar, or another area, most of the teachers who monitored their students' work contended that computers enhanced their ability to assess student skills and better target students who needed individualized instruction.

Teachers valued the computer because of the individualized instruction that it enabled them to provide their students. As one teacher indicated,

> I think it's great that everyone can work at their own pace on the computer because some kids need to go slower while others go faster. In order to get the point across to everyone in the classroom you kind of have to teach to the middle but computers give everyone a chance to work independently at their own level. Then I can help each student individually while everyone else is busy on the program.

Sharing similar regard for the computer, another teacher added that as she provided instruction on a one-on-one basis, computers helped her to establish a stronger working relationship with students. She said,

> Computers help in building rapport with students. They create a different learning environment and it's particularly helpful for students who otherwise are shy or more reserved in the classroom. I can get them to read to me or explain something off the screen whereas they would be more inhibited to do so in a larger group. For kids like that, computers make all the difference in the world.

Risk Taking

As teachers who engaged in a style of avoidance, teachers who embraced computers faced risks as they used them. They minimized the ill effects of the risks, however, through their preparation of lab time, an activity often overlooked by other teachers. For example, on introducing a program to her fourth graders, I observed one teacher take several extra minutes to warn her students of the "pitfalls" or glitches in the program they were about to use. Her familiarity with the program enabled her to guide the students around the problem areas.

These teachers also minimized risks by monitoring their own progress when they used new software. In one instance, a parochial school had a supplemental, computerized reading program for younger students that teachers could use voluntarily. A first-grade teacher from that school reported that she was using the program but was concerned that it might interfere with class progress. She indicated, however, that she was keeping a watchful eye on it:

> I can't say that it won't work until after I have tried it. You know I always have my lesson plan books from last year, and that way I can tell where I should be. I spot check every two months to see if I am on or off target and then move along or maintain or throw in a play if I am doing something where we are too far ahead. I'm withholding judgment on this new reading program until I see where the class is at Christmastime. But if I think the program is hindering class progress, I'm just going to go back to my old lesson plans until I can figure out another way to approach it.

Inevitably, potentially embarrassing situations surfaced when students confronted teachers with computer-related questions they could not answer or mechanical problems they could not fix. Perhaps bolstered by confidence gained through technical expertise, these teachers tended to skirt embarrassment, often by readily admitting their weakness or inability to solve all problems. In one episode, fifth-grade students were writing stories with word processing and illustrating them with computer graphics to give the stories as gifts to first graders. One boy encountered difficulties with his machine. The teacher tried but was unable to fix the problem. Apologetically she said, "You'll have to start over on another machine." Then she laughed and added, "I don't know what happened. Mysterious things seem to happen in this lab that I've never seen before!"

At other times, these teachers diffused embarrassing situations by looking to the class for assistance. I heard teachers address their classes with comments such as "I don't know how to do this. Does anyone else?" By turning a question into a cooperative problem-solving exercise, teachers reinforced their use of the computer as a teaching tool.

Quality-of-Task Reduction

Although integrators and technical specialists reported that they thought computers enhanced their teaching skills, it was, for the most part, these same teachers who experienced a reduction in the quality of some of their newly acquired tasks in relation to the quality of other teaching assignments. Many of the tasks that they perceived to be less appealing were chores involving computer management. Early on in the process of implementation, as Chapter 2 indicated, schools depended largely on these teachers as "champions" to assume the responsibility for computer-related tasks such as machine maintenance, booting the lab computers in the morning, supplying the printers with paper, and closing the labs at the end of each school day. Likewise, these teachers fulfilled committee functions involving management, scheduling, cataloging, ordering, and so forth.

Administrators often depended on these teachers to voluntarily extend their enthusiasm and technical expertise to the rest of the staff. They also called on technically experienced teachers to instruct other members of the staff. Frequently, principals asked them to provide tutoring sessions after school or to stage informal inservice training sessions. A principal reported to me, "I had a teacher who used the equipment with her slower second graders. She was so excited about her success that I asked her to show my other teachers how to do the same thing." Three teachers at one school organized a day-long workshop that I attended. Throughout the day they assisted other teachers and demonstrated new software and printing routines to the rest of the faculty. Other less informed teachers relied on their more proficient colleagues for tutoring, mechanical assistance, and curriculum guidance. Most often these efforts went without tangible rewards.

Teachers fulfilling managerial and tutorial tasks reported deriving satisfaction and benefit from computers. Although there were few instances in my data in which technical specialists voiced concern about these additional tasks, teachers engaging in integration indicated that they perceived the qualitative nature of many of these tasks as quality-of-task reduction. During interviews, for example, these teachers frequently registered complaints that focused on mechanical tasks involving maintenance or machine operation for others. They complained that other faculty members sought them out for all computer-related problems, regardless of whether they were of the magnitude to warrant expertise. One teacher recollected, "I was in the lab and a teacher asked me to help her with the printer. Actually, she didn't want help at all. She just wanted me to do her job for her." Another teacher lamented that the problem had gotten out of hand at her school. She explained that teachers, wanting simple technical guidance, frequently interrupted her during classtime and sometimes even called her at her home. She reportedly perceived those requests to be a real nuisance.

These teachers did not consider all of the additional tasks to be a reduction in quality, however. For example, they did not seem to mind additional responsibilities, such as tutoring or committee work, which they may have found to be intrinsically rewarding and compatible with their professional norms. For the most part, only those tasks that were mechanical in nature or those that made them feel that they were being used unnecessarily concerned them.

In summary, teachers who engaged in integration or technical specialization experienced both positive and negative consequences of computers on their jobs. When they used computers as a teaching tool or as an object of teaching, they realized skill enhancement as they developed and introduced computing projects for their students. They valued their ability to more accurately assess the learning progress of students because of computerized routines. Thompson (1983) argues that technology is a productive tool when workers are skilled in its use. It becomes an extension of the person using it. Such was the experience of these teachers. On the other hand, these teachers also became responsible for other tasks, some of which were mechanically based and were perceived to be menial and degrading. These teachers typically devoted part of their computer-related time each day to manual, routinized, and otherwise tedious activities.

Desire for Assistance

Hoping to reduce the negative effects of computing on their jobs, nearly all the teachers in local schools expressed the desire for additional staff to assume certain computer-related responsibilities. The teachers differed, however, in their anticipation of the functions that the staff person would fulfill.

Those teachers engaging in avoidance strategies most often expressed the desire for a certified teacher to assume full or primary responsibility for all computer-related activities in their schools. These teachers typically held concerns and insecurities about their computing skills, and rather than strengthen their own skills, they often indicated that to reduce their anxieties stemming from computers, they would prefer to relinquish their computing responsibilities to someone else. For example, one teacher from a parochial school told me the following:

> I would like someone in the lab teaching and introducing the children to the new disks. If I wanted to, all I would have to do would be to be in there, listen to her, and assist the kids if they needed help. Otherwise I would stay in my classroom and do something else. I don't want to plan that time.

Other teachers in all the schools agreed. One public school teacher said, "I find it very frustrating to plan a computer period on my own. I would like it very much if we had a computer instructor who would plan it and do it for us." Another admitted, "I don't feel qualified to be doing this. I would feel much better if there was a [computer] teacher in here." Whereas one teacher sharing this view told me that she intended to continue using computers with her students, she hastened to add, "But I really wish they had a computer expert instead of me down there to do it with them."

In contrast to those teachers wanting a person to assume full or primary responsibility for computing, other teachers hoped that their schools would hire someone to help them deliver more effective computing sessions. Typically these teachers wanted someone to function either as a resource person in their school, providing guidance for teachers in developing strategies of integration, or as a technical assistant, alleviating some of the more routinized and tedious tasks associated with computing management. For example, one of these teachers told me that she was fairly competent about machine operation and basic uses, but she wanted more guidance in how to apply what she had learned to what she taught. She said, "I'd like this school to hire a resource person, someone to sit down with me by myself and look at my lesson plans and tell me where they think computer activities would best fit into my plans and then show me how to make that work."

Discussion

A comprehensive model of technology and teaching must be sensitive to the contributions of teachers based on their styles of technology use and the mixed effects of the technology that can occur. To that end, a contingency model considers more closely the conditions under which upgrading or downgrading will occur (Barley, 1988; Kelley, 1990; Spenner, 1990). The model asserts that the effects of technology are conditional on intervening factors in the process of change, suggesting that when the autonomous activities of teachers are organized by computing styles, they will realize impacts of the technology relating to those styles.

The distinctly different sets of effects of technology relating to the computing styles of teachers presented in this chapter reveal that computers do not affect teaching and teacher skills similarly. Teachers who avoided computers gained mechanical skills as they learned to operate the equipment, but they did not regard those skills as meaningful to their jobs as teachers. The only effects of the technology that were salient among these teachers and caused them concern were those that, in their estimation, undermined their ability to perform their jobs effectively, such as risk taking and task displacement.

Embracing the opportunity to use computers, teachers who used computers for integration or technical specialization developed instructional skills and strategies that enhanced their work as teachers. As those engaging in avoidance, these teachers took risks as they applied the new technology in the instructional setting. These teachers, however, frequently were able to capitalize on these instances and use them as opportunities to reinforce learning concepts and the cooperative climate of the classroom. On the other hand, these teachers tolerated quality-of-task reduction as they performed tasks, such as machine maintenance, which they perceived to be menial, machine-related, or otherwise tedious. Although they continued to find computer technology meaningful to their jobs, they remained concerned about these negative impacts of the technology.

It is not unreasonable to expect that computing styles of teachers were reinforced and sustained because of effects of the technology and the concerns that teachers held. For example, the negative consequences of computers on the jobs of those who avoided the technology created frustration, resentment, and stress among users, and it encouraged them to continue to avoid unnecessary use of the equipment in an effort to intervene or reduce its ill effects on their jobs. On the other hand, although other teachers assumed responsibility for some undesirable, more tedious computer-related tasks, the positive effects of computing on their jobs were more salient to them, and encouraged them to seek opportunities to expand computer applications into their work routines to reap further benefits from the technology.

In hopes of minimizing the negative effects of computing and maximizing the positive effects, most teachers desired computer assistance. Their expectations of how someone could best address their computing needs differed. Chapter 6 examines the position of computer coordinator that evolved as a continued effort in schools to promote the use of computers and address the concerns and needs of teachers.

6

Shifting Responsibilities

Computer Coordinators in Schools

In response to the increasing demand for someone to deliver computer instruction as well as manage, coordinate, and integrate computer activities, schools have established the position of the computer coordinator. In many instances, this relatively new position originated informally, through the voluntary efforts of concerned teachers to promote the idea of computer technology in schools; however, for the most part the computer coordinator is that person who has recognized responsibility for the provision of computer instruction, resource coordination, curriculum integration, and equipment management, particularly in a computer laboratory setting. The computer coordinator holds a formal position of technology leadership within local elementary schools and as such may have a critical role in the implementation process.

Research on the implementation of new technology in organizations commonly links the success of the innovation, in part, to the efforts of technology leaders (Beath, 1991; Howell & Higgins,

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1990; Kanter, 1983). Typically, these are individuals who either informally or formally promote and champion the use of the technology in their workplace (Beath, 1991; Howell & Higgins, 1990). Because of their technical expertise and competence, coupled with their commitment to technological change, these leaders may be perceived as *good soldiers,* a term used to designate workers who comply enthusiastically with the goals established by their organization (Hodson, 1991b). Likewise, they may function as gatekeepers, gathering and disseminating technological knowledge to other potential users (Howell & Higgins, 1990).

In circumstances in which technical competence is a limited commodity, these leaders may be treated as organizational *tokens,* a term used to designate workers who because of certain characteristics are relatively few in number in an organization and consequently work under conditions of high visibility, pressure to perform, and social isolation (Kanter, 1977). Research reveals that technological change commonly is met with skepticism in organizations, and the attempts of these leaders to overcome this and foster change will most often depend on the political support available to them from within their organizations (Beath, 1991; Kanter, 1983) in addition to material resources, their own personality characteristics, and leadership skills (Howell & Higgins, 1990).

Successful integration of computers in schools, then, may depend on the efforts of computer coordinators (Kearsley & Lynch, 1992; Lieber & Cosden, 1989). Integration, or matching computer activities with instructional goals and into existing subjects (Collis, 1988; Preskill, 1988; Reinen & Plomp, 1993), is a complex endeavor, often requiring additional training and attitudinal change among users. To effectively integrate computers, users must have access to technical expertise and support (Kearsley & Lynch, 1992), and in many schools, these services are provided by computer coordinators.

Nationally, progress toward integration of computer technology in elementary schools remains limited, even in schools employing a computer coordinator (Becker, 1992; Collis, 1988; Reinen & Plomp, 1993). For example, in a national study of computing in elementary schools, Becker (1991) found that less than one third of the respondents reported that computers should be integrated into the curriculum and used as teaching tools, and fewer respondents reported actually using computers in that manner. Similarly, in a survey conducted by Lieber and Cosden (1989), computer coordinators reported that though they assumed primary responsibility for computer instruction for both students and teachers, they often performed tasks with minimal teacher consultation and that integration of lab activities with classroom work was minimal.

Despite the importance of the computer coordinator in the computer implementation process in schools, few studies have examined the circumstances surrounding the job of the computer coordinator and related issues. In this chapter, I focus on the role of the computer coordinator and the occupational dynamics between computer coordinators, administrators, and classroom teachers in local schools. Such an analysis of the coordinator in elementary schools may contribute to a better appreciation of this relatively new position and the conditions of work that accompany it, as well as the patterns of computer integration that presently exist in elementary schools employing computer coordinators.

Computer Coordination in Elementary Schools

The following sections examine both the structural and social conditions of work that characterized the job of the computer coordinator in local elementary schools. These conditions contribute to low levels of computer integration in the schools and high levels of job turnover for the computer coordinators.

Employment Arrangements and Responsibilities

Although most schools in the local community did not employ individuals specifically for computer coordination in the earlier stages of computer implementation, they had reduced their dependence on coordination offered voluntarily by classroom teachers or parents and formally employed computer coordinators by the time that I returned to schools in the second phase of the study. The employment arrangements of computer coordinators varied in each of the elementary schools participating in this study. All of the coordinators had full-time jobs, but they distributed their time differently. Less than half of the schools employed computer coordinators full-time, that is, all day 5 days per week, but in two of those instances, a full-time aide assisted the coordinator. The rest of the schools employed computer coordinators on a part-time basis with no aide. In several cases, a full-time teacher who previously had managed computing activities voluntarily officially split his or her time equally between classroom teaching and computer coordination. The remaining schools employed coordinators on a part-time basis ranging from 1 day per week to 4.5 days per week. In the latter case, one of the days was staffed by one coordinator and the remaining days were staffed by another. The inconsistencies in these employment arrangements reflected, in large part, financial constraints and faculty decisions expressed through site-based management.

Recognizing that any part-time arrangement was probably less than optimal, many of the administrators and classroom teachers from the schools employing a part-time coordinator admitted that they would like to see their school hire a computer coordinator full-time but funding would not permit it. One principal explained, "My teachers are interested in getting more expertise in the building from a computer person but in order to do that they will have to do with less art and music. There's not enough money to go around for everything." This comment suggests that perhaps the faculty's priorities coupled with funding, rather than funding alone, prohibited the school from hiring a full-time coordinator.

Regardless of full-time or part-time employment arrangements, classroom teachers and administrators reported that they were pleased to have a computer coordinator working in their school. One teacher said,

> I am grateful that we have a computer teacher. She is a super addition to the faculty. My skills with the computer

> aren't that great so it's nice to know that someone who is qualified can give the students the proper direction and instruction that will help them make the best use of the computer.

A teacher from the public system similarly reported, "The coordinator here is very impressive. She's way beyond the call of duty."

Coordinators, on the other hand, often expressed the opinion that classroom teachers appreciated them for a different reason, specifically, because they might alleviate the computing responsibilities of other teachers. One cynically stated, "They [classroom teachers] are grateful that I am here. They think, 'Thank you for doing this job. Now I don't have to.' " A public school principal concurred by saying, "The teachers in this school wanted a computer teacher because they didn't want to be in there [the lab] themselves."

Administrators, teachers, and coordinators diverged on this issue of responsibility. The coordinators unanimously reported that they, along with faculty and administrators, should assume equal responsibility for the promotion and integration of computing. This view was indicated by a coordinator who was concerned about computer implementation in her school:

> I know of a fourth/fifth-grade teacher who is not taking advantage of the laptop computers. That means her kids are falling behind the others. It will have to be confronted. I don't know if it is my place or the principal's though. I think I'll talk to her about it and see what she feels we need to do.

In contrast to coordinators, only half of the administrators (representing schools employing both full-time and part-time coordinators) with whom I spoke shared the view that computing was everyone's responsibility. The remaining administrators and almost all of the teachers told me that, in their opinion, the coordinator should assume full responsibility for computer implementation, promotion, and integration. One assistant principal reported,

> I think our coordinator should do everything that relates to computers. It should not have to be the responsibility of team leaders, the principal, or the teachers. With the amount of work and extra duties that teachers have, it is to their advantage to have someone else worry about computing.

In any case, the coordinators reported that they were seriously hampered in their attempts to promote and integrate computing.

Tasks and Favors

The computer coordinator remained largely an undefined position in the elementary schools. The coordinators participating in this study were not bound by a formal job description, usually because one did not exist in their school. Although they acknowledged that computer instruction and promotion of computing were their primary responsibilities, computer coordinators performed a wide variety of tasks. Among those mentioned most frequently were faculty training (both during and after school hours), technical repair and troubleshooting, software selection and ordering, lab scheduling and management, and computer-related curriculum development. Coordinators also served on technology committees and, in several instances, wrote grants relating to technology acquisition. In short, these individuals took over all or most of the responsibilities that previously had been fulfilled by computer champions or committee members. Overall, the list of tasks reported to me by coordinators was highly consistent with findings from other studies of technology leaders in schools (Becker, 1991; Kearsley & Lynch, 1992; Lieber & Cosden, 1989). In almost every school, the computer coordinators, as the other teachers, also performed their share of general school service, such as bus duty, lunchroom monitoring, and so forth.

In addition to tasks that they perceived as part of their job, computer coordinators reported that, repeatedly, they were asked to perform tasks that they perceived as outside the boundaries of their jobs. Often, these tasks were construed as personal favors and translated into additional work. Perhaps because the computer coordinator was a relatively new position in elementary schools, the boundaries between job responsibilities and personal favors were not clearly established and remained ambiguous. These favors ranged from simple chores to bothersome interruptions and outright exploitation. The coordinators did not seem to mind the simple chores that most typically consisted of creating and printing banners or announcements. One coordinator from a public school said, "I run off banners all the time." Another explained that she was not bothered by those kinds of requests. She said, "Yes, yes, I'm asked to do favors quite frequently. I mean I don't mind doing them because I can type whatever it is in five minutes and it just prints out. No big deal."

Other tasks that coordinators perceived as bothersome were those that interrupted their more normal work routines. Interruptions generally took the form of troubleshooting or quick repair. Most accounts were similar to this one from a teacher in a parochial school: "If teachers have, or think they have, a technical or mechanical problem, they call me immediately, no matter what I'm doing. They forget that I'm up here teaching, too. They call in on the intercom and tell me I need to fix something right now." Coordinators reported that when these occasions arose, they generally had to abandon their own classes or have the classroom teacher stay in the lab until they attended to the problem.

One public school coordinator devised an effective solution by training her own "squad" of students who would scurry off to the aid of other teachers when necessary. For the most part, however, coordinators responded to teachers on demand, particularly in instances when technical problems arose. Teachers did not seem concerned about disrupting lab instruction. One classroom teacher explained, "I don't think our coordinator minds constant interruption. Maybe she does, but she doesn't show it."

All but two of the coordinators reported experiencing requests for tasks that they perceived as exploitative. Perhaps because one of these coordinators was male and the other had been a teacher in her school for nearly 20 years before taking on the job of computer coordinator, teachers were discouraged from requesting personal favors of them that were exploitative in nature. In some instances, these were favors involving the completion of other people's work. A coordinator from a public school revealed that, frequently, she was asked to finish secretarial work at home. She said, "I'll get things from the office and they'll say, 'Could you do this tonight? You know, we need this and I know you have the program at home.' It is usually spreadsheets, printshop, or word processing." A coordinator from a parochial school reported that, in addition to helping out with secretarial work, she regularly was asked to do extra, time-consuming work because no one else in the school knew how to use the computer program required for the task. Several other coordinators, from both the public and parochial schools, said that they commonly were asked to substitute or fill in for classroom teachers if they left the school building for a portion of the day. In those instances, the coordinator's computer classes were cancelled for the time that she was substituting.

The most extreme instances of exploitation involved increasing the workload of the coordinator to decrease the workload of the classroom teacher. Hodson (1991a) found that this intentional shift of work from one worker to another is a common tactic of infighting among coworkers and is particularly likely in settings where there is ambiguity about job responsibilities and duties. There were several instances in my data in which coordinators described such episodes. For example, a coordinator from a parochial school recalled, "Right now, teachers see me as their free period. They use my flex time to sign their classes up for extra computer time so that they get extra free time." Similarly, a public school coordinator reported, "One time they tried to put too many kids in my room to free up time for a teacher. I can't take 35 kids. I have only 29 computers that work." She added, "It really irked me because, to protect myself, I have to complain and I hate to do that. I had a run-in with the principal over it."

As the evidence suggests, the role of the computer coordinator is an ongoing process of negotiation between school administrators, classroom teachers, and the coordinators. The role is accompanied with certain performance pressures with which the coordinator typically complies. Pressures to perform often accompany highly visible jobs (Kanter, 1977), particularly jobs that are accompanied by a high degree of uncertainty. Finding it difficult to gain credibility, Kanter (1977) determined that organizational tokens worked harder than others to make their skills known and to prove their competence.

It is important to note that, for the most part, many teachers and administrators perceived coordinators as technical "gophers" who were willing to accommodate the needs of others under most circumstances, and in turn, coordinators endured the pressure to perform personal favors. Likewise, the data suggest that in some instances, especially those involving simple chores, they came to accept those additional favors as part of their job. It is also likely that coordinators performed personal favors to gain peer acceptance and reduce resentment, two conditions of their work that are addressed in the following sections.

Isolation and Avoidance

Nearly all of the coordinators reported feeling socially isolated in their jobs and they agreed that any part-time employment arrangement particularly hindered a coordinator's attempt to become part of the school community. The feeling of isolation that commonly persisted most likely stemmed from several sources, including the physical distancing of the computer labs, many of which were in rather inaccessible locations. As Chapter 2 indicated, the computer labs in two schools were situated in separate buildings that were close to but not attached to the main school buildings. In another school, the lab was located behind the library and, unlike the classrooms, could not be accessed from the main hallway. The labs of several other schools were located in basements, away from the main flow of traffic. This physical isolation characterizing the work of computer coordinators may heighten social distancing and misunderstanding about what goes on in the computer lab.

Physical isolation contributed to but did not entirely account for social isolation. Another factor adding to the isolation experienced by coordinators was their lack of access to formal channels of communication with administrators or other faculty. None of the coordinators met with their principals on a regular basis and, in fact, several of them reported that they had not met with their principals that year, other than in passing in the hallway. Likewise, in each of the schools, teachers from similar grade levels grouped together for instructional teams, but, typically, computer coordinators were not assigned to any one particular instructional team as their services were pertinent to all instructional levels. The instructional teams usually met on a weekly or bimonthly basis to plan and discuss various concerns and teaching strategies.

With the exception of one school, however, coordinators were not invited or expected to attend team meetings at all and, therefore, were excluded from dialogue, discussion, and networking with coworkers. Their exclusion from team meetings, as well as faculty meetings, set them apart from the classroom teachers and added to their isolation. In addition to impeding potentially fruitful interaction with colleagues on a regular basis, several of the coordinators reported that they felt their absence from those meetings was probably a source of resentment among the other faculty. Even though her principal did not expect her to attend team meetings, one coordinator explained, "It upsets the teachers that I don't go to those meetings. They look around and they're wondering where I am."

Realizing that their opportunity for communication with other faculty members was somewhat limited, coordinators made overt attempts to establish informal links, particularly for instructional purposes, with other teachers. For example, most of the coordinators told me that, at one time or another, they asked teachers to put notes in their mailboxes pertaining to any problems, requests for software, or other relevant questions they might have. All of them confessed, however, that they rarely, if ever, received any responses to those requests. One coordinator recalled, "I used to have notes that teachers could come in, fill out, and leave for me. They never used them. I even put one in their mailboxes at the beginning of the school year, explaining where they could find more of the forms. I never got any back." Another coordinator indicated that the problem was prevalent in other schools as well as her own. She said, "I know from my fellow coordinators that we all have to face this. We get no communication. The teachers don't volunteer information."

In their survey of lab coordinators and teachers in elementary schools, Lieber and Cosden (1989) similarly found that opportunities for communication between coordinators and teachers were reduced. In that study, only one respondent reported having regularly scheduled meetings with teachers, whereas the majority of respondents reported that if any meeting occurred at all, it was on an informal basis. The conditions reported by coordinators in local schools, along with those reported by Lieber and Cosden (1989) demonstrate that coordinators are excluded from formal channels of communication and networking in schools.

A third explanation accounting for the social isolation experienced by coordinators was that, in many instances, classroom teachers who practiced the computing style of avoidance themselves developed additional strategies enabling them to avoid the efforts of coordinators. For example, I observed that these teachers never entered the labs with their classes, either when taking them to the labs or when picking them up from the labs. Usually, they did not speak to the lab teachers either. When asked about this, the teachers and coordinators verified my observations. One coordinator related, "Teachers never come in the lab or initiate conversation with me. As a matter of fact, sometimes I run out the door after them saying, 'Oh, by the way, this is what your students learned today.' It isn't like they ever come in and ask."

The coordinator of a lab that was located on the second floor of another school said, "Most teachers in this school stand at the bottom of the stairs and send the kids up. I don't ever see them [the teachers]." Other coordinators shared the same problem. Even when teachers needed something from the lab they often sent someone else, such as a student or aide, to fetch it rather than go themselves. For instance, one teacher reported that to change the software disks in her classroom's computer she either traded disks with other teachers on her floor or sent her aide to the lab to find something new.

Teachers also avoided other efforts of coordinators designed to promote the use of computers, and repeatedly, coordinators shared accounts with me that attested to these avoidance patterns. During an interview at the end of the school year, one coordinator revealed that no one in her school had asked her for different software since Christmas. Several coordinators told me that they offered informal training sessions after school and nobody showed up. A public school coordinator said that because the teachers in her school did not seem to know what to do with computers she had prepared lesson plans for teachers involving computer activities but no one used them. She admitted, "It got to be kind of a waste of time so I stopped."

Several coordinators reported that they had placed computing materials in the teachers lounge because teachers did not come to the lab, but even in those cases, the efforts were in vain. For example, the coordinator from a parochial school reported that although she had prepared and placed a catalogue of her school's software in the teachers lounge, no teachers had examined it. She said, "It hasn't moved. It's still sitting in exactly the same spot on the window sill and nobody has used it." In another similar instance, a coordinator said she had set up a new computer in the teachers lounge but it remained unused, so, eventually, she moved it to the lab. One public school teacher summed up the situation by simply saying, "Avoidance is status quo at this school."

On contemplation, most coordinators tended to relate the avoidance patterns among teachers to the issue of planning time. In all but two schools, teachers gained a planning period while their students were with the computer coordinator in the lab. One coordinator remarked, "I am equated to planning time for teachers. Last year the principal so much as told me that. He said, 'The reason why you are here is that you are planning time. And if any learning happens to be going on in the lab, then I consider that a bonus.' " This individual indicated that planning time was at the root of her own problems concerning social isolation as well as other problems involving the computer program in her school. Other respondents agreed. One coordinator confided, "Two of the primary teachers made the statement that if they did not get a free period out of the deal they weren't going to bother with computing at all. It had nothing to do with me, but it had everything to do with their planning period." In fact, one school eliminated the planning time for its teachers in an effort to increase computer use among classroom teachers. The coordinator in that school reported that she literally was shunned in the aftermath. She stated, "The teachers didn't talk to me for about two years after we decided they would have to start coming to the lab and staying there with their students."

Whereas coordinators tended to associate teachers' avoidance patterns to planning time, teachers held a different perception involving their time and job responsibilities. When asked why she did not ever go into the computer lab at her school, the second-grade teacher who had switched roles to avoidance explained, "Because now I have a computer teacher, an expert to do it. And I don't have time to go the days of the week that she's not here." A third-grade teacher from a private school indicated that this view was prevalent in her school as well. She said, "The more I stay out of his [the coordinator's] way the better. I think that it is a common attitude. People feel like they have so much to do in here that they can't think about anybody else or about doing anything else." On the other hand, one public school teacher based her decision to avoid the lab on her own level of computer expertise. She reported, "I never seek help unless I absolutely have to because I know that a lot of other teachers need it more than me. I think our lab person should be about helping those that really need it."

Not unlike the conditions under which tokens worked in Kanter's study (1977), the evidence presented in this section reveals that through their physical and social isolation, coordinators were excluded from formal and informal peer networks in their schools. Denied these important opportunities to discuss strategies or demonstrate their capabilities, it seems likely that their influence in the integrative process would be restricted. Unable to exhibit their use of time, it also seems likely that they would become the target of sharp scrutiny in their schools.

Jealousy and Resentment

Most of the coordinators revealed that they sensed jealousy and resentment from other teachers, particularly over issues of planning time and money. As with full-time classroom teachers in their schools, full-time coordinators also had planning time scheduled into their workweek. One coordinator in a public school confided that the teachers in her school perceived her to get more planning time than they, when, according to her account, over a month's time she got less. She explained that she actually did not get much planning time at all because during that time she was usually answering questions from teachers about new equipment, such as the laptop computers her school had recently acquired, or she was doing personal favors, such as creating banners or taking extra students. She concluded by saying, "I'm working more now than I did as a classroom teacher. Just because I don't have a group of students tagging along with me doesn't mean anything. Teachers think that if their kids aren't in your room, you must not be doing anything." This attitude probably extended from classroom teachers whose personal computing practices included strategies of avoidance, which emphasized routine computer applications such as drill and practice or word processing and created "off-task" time for instructors.

A few coordinators indicated that sacrificing their own planning time to do extra tasks and personal favors was a way of reducing the possibility of becoming a target among other faculty, as illustrated by one coordinator in a public school:

> I don't get resentment like some of my colleagues because the first year I was in this school I did bus duty and ramp duty. I am pro-active. I go to teachers and say, "I'll take your class" or if they want banners done I do them during my planning period.

Another issue promoting jealousy was the allocation of money and other resources for computing supplies. Recognizing the jealousy directed at the computer coordinator in her private school, one teacher explained,

> He gets more credibility and funding in this school. There's jealousy there because, to a large extent, anything that says computer, you get money for. I can see that for people who aren't comfortable with computers, that's a real bone of contention.

Similarly, a coordinator from a public school said that she was responsible for allocating money in her school to buy equipment and software and this caused a great deal of resentment among classroom teachers. She explained, "When a teacher's request is honored, other teachers perceive that money as going to the individual teacher instead of for supplies that can be used by everyone." Likewise, she added, teachers resented her authority when she denied their requests for money. At the conclusion of our interview she added, "Money is readily available in most schools for technology and lots of lab teachers have this problem."

There was a strong sentiment expressed among nearly all the coordinators that classroom teachers lacked understanding and appreciation of their work and that, as a result, they or their jobs were closely scrutinized. A public school coordinator reported, "I was a classroom teacher for six years before taking this job. I was not used to other teachers looking at me and wondering what I did with my day, but they definitely do that now." In many instances, coordinators stated that they believed teachers compared their jobs and workloads unfairly. A coordinator from a parochial school explained,

> All the teachers see me and the other "specials" as having a real plush job. We don't have homerooms. We don't have to deal with the kids all the time. But we do, we have to deal with all the kids all the time. It's just that we don't have the same 30 kids all day.

Another coordinator added, "They [the teachers] really think that this is a much easier job than being a classroom teacher."

Even principals in several schools seemed to share the perception that computer coordinators did not carry a full workload in comparison to classroom teachers. One told me, "She [the coordinator] and the other 'specials' have more planning than the other teachers. Also she doesn't have a homeroom or homeroom responsibilities." Very few coordinators believed that their principals supported their efforts. Speaking of her principal, one coordinator said, "I have been left to defend myself. My principal is a dynamic person and extremely sympathetic but he doesn't want to get involved."

The most overt demonstration of jealousy was described by a full-time coordinator in a public school. There, she explained, a group of teachers formed an ad hoc committee to restructure her time and, in the process, they eliminated her planning time. She was not part of the decision-making group and, in fact, was not informed of the effort to restructure until the decision was formalized. The coordinator expressed a great deal of bitterness about the experience and her sense of powerlessness in that situation. When I discussed this episode with the principal in her school, he told me he empathized with the coordinator. He said, "She has a difficult position in that she must service 28 other teachers. The teachers see her job as easy but they don't stop to think that she must appease all of them." Even though he seemed to understand the difficulties she faced, he did not support her in the decision-making process. He remained uninvolved.

Low Integration—High Turnover

The climate within which coordinators worked, which was marked by lack of interaction—formal or otherwise—between coordinators and teachers and by misunderstanding, almost dictated that computing activities would not be integrated or coordinated with the more regular curriculum in the elementary schools. For the most part, teachers, coordinators, and administrators agreed that computer activities were unrelated or were, at best, loosely tied to classroom curriculum. Speaking of the part-time coordinator in her school, one classroom teacher said, "I think it's her own program due to the restricted amount of time that she's here. We don't have a chance to correlate anything. I touch bases though, once in a while." Another teacher in a school employing a full-time coordinator said, "I just let our coordinator decide what to do. I can't say that I ever take the time. Whatever she picks is fine with me. I don't really care." Similarly, coordinators admitted that they worked independently of teachers. After teachers repeatedly rebuffed their attempts to establish communication several coordinators said that they felt forced to "set their own agenda." As one explained, "The students come once a week to me and I, by virtue of my own classroom teaching experience, know the curriculum. I know where they should be. But I'm pretty much developing my own computer curriculum." Another coordinator said that in her school there was one fourth-grade teacher who, having been a computer coordinator herself, sent notes several times throughout the year describing where her class was in their lessons. The coordinator went on to say, "I would kind of take her lead and plan for the whole fourth grade, knowing that they probably are working on the same areas."

The employment arrangements involving part-time lab coordination particularly promoted fragmentation and inconsistency rather than coordination and integration in the delivery of computer instruction in the schools. This was a serious problem voiced by every part-time coordinator. A coordinator employed by a public school one day per week expressed her concerns, "I'm at a school where I see a first, fifth, fourth, and second grade every Tuesday. It's so mishmash. There's another teacher here on Mondays so we're not together, we're not in sync, there's no continuity." Another coordinator reported,

> There is poor communication, particularly if you are a part-timer. One year I had three schools. I was so fragmented and didn't really know the teachers very well. They forgot my name and usually forgot what day I was there. It is really difficult when you have more than one school.

Although it did not seem to concern teachers, the lack of coordination and integration frustrated the coordinators, and most of them felt that their services were undervalued in their schools. A public school coordinator reported, "No one perceives this as an important learning experience. You know, we're called the 'specials'; art, music, library, computer. And that's what it is, it's just something extra and special that the kids get to do, but not a real learning experience." The coordinator in a parochial school reported a similar observation:

> The computer is a tool but it was never seen that way at this school because it is treated as something separate. In fact, we even have a separate place on our report card that says computer. So the children see it as something separate from math, reading, and so forth. It never got integrated.

Other evidence also suggested that computer time was itinerant and undervalued. For example, several coordinators said that when they were sick, they were not replaced with a substitute for the day, but rather, the lab stood empty.

Despite the difficult working climate that coordinators faced in their schools, coordinators seemed to like their work. They reported that they liked the autonomy it offered, as well as the challenge and satisfaction they derived from working with students and computers. Likewise, they said they felt rewarded on the few occasions that their efforts to integrate computing activities were successful.

Even though coordinators tended to like their work, the role ambiguity and the conditions of social isolation, resentment, and so forth that accompanied the position of coordinator most likely led to high turnover of coordinators in schools. Though the position of computer coordinator was a relatively new one, all but one of the coordinators in the schools participating in this study had replaced a previous coordinator when they took their current job. Less than half of the coordinators indicated that they intended to remain in their current school for the following year, and of those, only two had worked in their current school for more than 2 years. On the other hand, the majority of coordinators, particularly those in the public school system, reported that they intended to switch schools for the next school year. In changing schools, some of them hoped to escape the difficult working climate that they had encountered in their current school. One coordinator explained, "This school has a bad problem with teachers bitching. The person who had this position last year left because the other teachers had it in their mind that this was a meaningless kind of job." This particular respondent contacted me a month after our interview to say that she had taken a coordinator's position in a new school for the coming year.

The coordinators who sought new schools for the next school year reported that even if the working climate that accompanied their position was similar in their new school, they were jockeying for a full-time position in one school. Realizing the unlikeliness of that possibility, however, most of them said that they hoped to improve their job by getting more desirable schedules, school locations, or schools in the following year. Finally, two coordinators reported that they were leaving their schools for different positions at the end of the school year. Seeking other challenges, one of these individuals was moving on to an administrative post and the other, unwilling to endure another year of frustration, was returning to classroom teaching.

Discussion

This chapter provides information regarding structural and interactional dynamics among computer coordinators, principals, and classroom teachers that may affect the degree to which computer integration will occur in elementary schools. Although the schools employed computer coordinators, the integration of computing activities in schools was reportedly low.

Structural characteristics involving the employment arrangements and job definition of computer coordinators led to ambiguity and inconsistency in job performance. Likewise, social dynamics in the schools produced social isolation, rejection, and scrutiny that for the most part were imposed by classroom teachers, sanctioned by principals, and endured by computer coordinators. These conditions are similar to the workplace conditions of organizational tokens (Kanter, 1977). Because computer coordinators possessed expertise and technical competence, both of which were necessary for change and in high demand, they were treated as tokens. Their jobs were highly visible, yet largely undefined. They were under pressures to perform, but their efforts were ignored, avoided, or otherwise undervalued. Unable to gain peer acceptance and legitimation of their work in the schools, coordinators became the target of peer resentment. Moreover, social conditions in the schools prohibited any attempts on the part of coordinators to integrate computing because they and their jobs were perceived as itinerant to the rest of the curriculum.

Another plausible explanation accounting for the social conditions surrounding the job of computer coordinator is rooted in expectations associated with different styles of computing. It is possible that schools employed computer coordinators to assume certain computer-related responsibilities based on one style of computing, whereas the individuals filling those positions may have held other notions about computer coordination based on a different style of computing altogether. In fact, the last section presented in Chapter 5 contained accounts from teachers expressing different expectations regarding computer assistance.

For example, if the teachers in a school predominantly engaged in "avoidance," it is likely that they would expect a computer coordinator to reinforce their ability to further avoid computers. This would account for the pattern discussed in this chapter whereby classroom teachers avoided the computer lab and efforts of the computer coordinator to communicate or integrate computing activities with their classroom routines. This would also account for the style switching that was discussed in Chapter 4, whereby teachers who, in the earlier phase of the study, indicated characteristics of integration had reverted to avoidance on the employment of a computer coordinator in their schools.

Second, if teachers are unaware of the different styles of computing among users, it is likely that they would assume that a computer coordinator would use computers in much the same way that they did. If those teachers were most familiar with avoidance strategies, particularly the repetitive use of drill-and-practice routines or other software creating off-task time for instructors, it is likely that they would assume that the coordinator, too, used computers in similar ways. These assumptions, coupled with the physical isolation of the lab and social isolation, would create conditions whereby the role of the computer coordinator would be largely misunderstood and resented. The position of computer coordinator represented an occupational advance for individuals who moved from classroom teaching to computer coordination. The real gain of these individuals occupationally, however, is best understood when viewed in the context of other opportunities for occupational gain that computers may have created for teachers. This topic is addressed in Chapter 7.

7

Computing and Occupational Rewards for Educators

New technology offers educators an instrumental resource with which they may strengthen their own positions organizationally. Yet the occupational rewards that teachers have gained as they continue to develop important skills relating to computer technology remain a topic that is misunderstood and underresearched. In an environment that traditionally has been characterized by relatively limited structural rewards, the opportunities for gain among teachers created by computer implementation may have critical implications for the structure of work at the elementary school level.

Occupational rewards are important motivators and reinforcers in the workplace. Rewards can elicit movement toward goal achievement among workers and also are related to increased productivity, worker participation, and job satisfaction (Hall, 1995; Kanter, 1977). The most overt reward systems include promotions, salary schedules, bonuses, merit increases, fringe benefit packages, and so forth. In addition to concrete gains, however, intrinsic rewards such as positive working conditions, recognition, and status also reward workers for their effort.

Recent studies examining the relationship of occupational reward structures to new technology reveal that, depending on how the technology is used, new technology offers workers important access to organizational gains (Barley, 1986; Disprete, 1988; Finlay, 1988; Kraemer & King, 1986). Technical expertise commonly results in increased status for users. Kraemer and King (1986) note that computing is an appealing activity. Computer users in their study were perceived to be "advanced, sophisticated and professional." In addition to increased status, Barley (1986) found that when CT scanners were introduced in radiology departments, medical specialists became increasingly dependent on personnel who were technically expert but who had limited medical knowledge. This was particularly so in instances in which mechanical problems arose. Barley concluded that, along with status, technicians gained power and autonomy because of their technical skills even though they had little medical expertise.

Finlay (1988) similarly found that some workers in the longshore industry gained occupational rewards in the form of increased power as a result of technological change. Specifically, skilled crane operators increased their influence in negotiating deals with their supervisors when standardized containers and machines to handle break-bulk cargoes were introduced in their workplace.

Whereas these studies commonly find that technical expertise results in increased status and power for competent users of new technology, they do not adequately explore outcomes involving these rewards or more overt occupational gains such as promotions and career movement, particularly over time. An examination of the consequences of computer technology for competent users in the educational arena offers an opportunity to consider this issue in greater depth.

Teachers traditionally have lacked significant economic incentives for their work. Remuneration most often is tied to length of service and level of academic preparation (Clifford & Guthrie, 1988) rather than work performance. In contrast to other occupations, the earning power of teachers typically peaks after approximately 15 years of service (Clifford & Guthrie, 1988; Guthrie & Reed, 1986), regardless of merit, acquisition of relevant teaching skills, or continued professional development. In the absence of opportunities for obvious monetary gains through promotion, teachers may pursue alternative rewards. For example, they may seek positions as specialists or administrative assistants because these positions are associated with noneconomic rewards such as increased discretion, prestige, and recognition (Guthrie & Reed, 1986). Competition for these positions, however, is high because of their limited availability in schools. When effectively integrated into their work routines, however, computers may offer teachers an important instrument with which they may become more competitively positioned to receive occupational rewards such as increased status or position reinforcement within their schools, or other more overt rewards including important lateral moves or promotions.

Hodson (1991b) argues that workers who promote organizational goals deliberately or inadvertently may gain rewards for their efforts. This raises questions regarding the access of occupational rewards available to teachers for their contributions in the process of change. Can we expect some teachers, specifically those adhering to an integrative or technically specialized computing style, to gain some form of special recognition or other, more overt, occupational rewards for their efforts? If so, what is the nature of these rewards? Moreover, are these rewards similarly available to all teachers who use computers or only those who demonstrate stronger computing styles? The purpose of this chapter is to address the complexities of reward acquisition relating to computing patterns among educators in elementary schools.

Computing and Rewards

There is no evidence to suggest that computer expertise determines promotability, but based on the experiences of those teachers who were able to capitalize on their computing strategies to gain formal positions as computer coordinators, it is likely that computer expertise improves one's promotability, reinforces one's position, or expands opportunities for gain in other ways. Early on in the implementation process, teachers participating in this study anticipated that would be the case. At that time, one respondent forecasted that computer skills would actually become "a ticket out of teaching." In addition to this teacher, many others whom I spoke with shared the perception that the "door was wide open" for anyone wishing to pursue occupational rewards based on computer-related achievements. The following sections examine the nature of the occupational rewards that educators gained over a 4-year period.

Status and Responsibility

Throughout the process of implementation, computers created opportunities for teachers to gain a high level of visibility, recognition, and status within their schools and in their school communities, depending largely on their style of computing. For example, one fifth-grade teacher who regularly frequented the computer lab stated, "I think other teachers look to a few of us that they know hang out here in the lab for help. They think we are some kind of a unique brand of people." Teachers in other schools concurred. One second-grade teacher said, "I've helped out sometimes when a teacher is in a bind and the perception is 'Oh gosh, you know how to do that!' " Another teacher agreed, saying, "I'm considered to be a hero around here. My friends here hold me in awe because computer skills are something they really don't have." The impression that teachers gained status because of their computing activities was reinforced by other teachers who avoided computing as well. One such public school teacher reported, "We run to the teachers who know computing. They're gods."

Recently, as schools have begun offering limited monetary rewards as incentives for computing, some teachers have relied on their computing strategies to gain additional money. For example, at private school, one teacher was paid an ongoing stipend for her contribution to the management of their computer program and another teacher at the same school reported that she had been awarded several grants over the years to further develop the school's computer program. Several other respondents noted that they conducted summer computer programs at their schools for extra stipends.

In addition to increased status and opportunities for financial rewards, avid computer users reported gaining noticeable recognition and increased responsibilities, particularly involving computer management, over the last 4 years. Most of these teachers were involved in their schools with activities such as grant writing and administration, decision making, and committee work. By participating in these computer activities respondents gained important decision-making power, high visibility in their schools, access to valuable knowledge, and important leadership experience. One third-grade teacher disagreed, however. Having become the technology team leader of a group of primary teachers in her public school, she was quick to point out that this did not carry status with it. She explained, "It's not a job most people want in this school. It is just extra work. It makes you have to be in the office a lot of the time."

Although it was likely that their computer expertise coupled with their additional job experiences was likely to bring them additional marketability, many of the teachers who acquired increased status and recognition in their schools seemed to be fully satisfied with their jobs and expressed no intentions of changing. One second-grade teacher from an urban public school explained,

> Maybe I don't have many high aspirations but actually I'm perfectly content doing exactly what I'm doing. I love teaching school and I love being in the classroom. As long as I can remain a classroom teacher, doing what I'm doing, I'll be fine. My computer skills help me to stay where I want to be.

In contrast, however, other teachers capitalized on their increased status to obtain transfers into other jobs or to other schools.

Horizontal Movement: Switching Schools

In circumstances, such as elementary education, in which vertical movement is limited, horizontal movement becomes valued. It is likely that computer skills enhance the ability of an individual to maneuver or jockey more successfully for job openings in other schools. One public school principal shared the following observation:

> It is hard to be promoted as a teacher. You can seek an administrative promotion, but you have to do the degree work. Otherwise, it's based on seniority. Although we don't normally distinguish between teachers, if a teacher has computer skills she can move around if she wants to.

The pattern of "moving around" to which this principal referred in the previous statement involved respondents transferring to schools they considered more desirable than their previous schools because of either working environment or location. These teachers seemed certain that computing skills increased their "transferability." All of the transfers were initiated either by computer coordinators or by classroom teachers, and all of them were obtained. One respondent explained that because of her experience and status as a computer coordinator at a time when most schools did not employ a coordinator, she was effective in negotiating a job transfer for herself. Perceiving the work climate in her previous school to be unsupportive of her position, she became dissatisfied and wished to transfer schools. On learning of an opening in another school, she applied. Shortly thereafter, the principal contacted her for an interview and seemed very anxious to recruit her because of her computer expertise and experience as a coordinator.

The respondent noted that her job satisfaction as a coordinator had increased because the working climate in her present school was more positive than in her previous school. She said, "I think this principal expects more out of the computer lab. She expects to see these kids produce and she expects to see the lab used. She has given me more responsibility and credibility than I ever got from my other principal." This respondent argued that computer skills enhance one's credibility. She stated, "I think you are judged and evaluated by how progressive you are. And I think computers just happen to be one piece of that. If you don't have computer skills you are considered to be old-fashioned and not quite as good a teacher."

Another respondent, a 45-year-old intermediate (Grades 4 and 5) teacher in the public system, transferred from a school located in an urban area to one in a suburban neighborhood and in so doing, moved from a school where she had been instrumental in developing a strong computer program to a school that was interested in establishing a computer program. She had initiated a transfer to challenge herself professionally; as she explained,

> I don't look at classroom teachers as being promotable. I would not like to be a principal. I would not like to be a computer coordinator. I like kids and I like the magic of creating classrooms. That's why I do it. I love my job. Rather than promotions, I look for lateral movement. That's one way I can keep burnout from setting in.

In describing the role she thought her computer skills played in her recent transfer, she explained,

> Because of my classroom talents, particularly computer skills at the moment, I see myself as becoming increasingly more valuable in terms of lateral movement. This principal would have played any kind of game to get me. I didn't quite have the seniority to transfer into this school so he played games and pulled strings to get me here because he knew of my value.

Upward Movement to Computer Coordination

The strongest pattern of gain involved respondents who attained formal positions of computer coordination since my earlier visit to their schools. Prior to this move, all but one of these individuals had been classroom teachers. For the remaining person in this group, a 42-year-old male in a private school, the job represented a career change from broadcasting to education, a move he said he had contemplated and for which he had been preparing for several years. This change does not constitute a promotion involving increased pay. Nevertheless, when compared to classroom teaching, the position is accompanied with higher visibility, more autonomy, and greater decision-making power, characteristics commonly associated with job satisfaction (Hodson, 1984) and that potentially can lead to promotion.

As Chapter 6 indicated, the computer coordinator is a relatively new position in most elementary schools and remains largely undefined. The coordinators participating in this study were not bound by a formal job description, usually because one did not exist in their school. Although they acknowledged that computer instruction and promotion of computing were their primary responsibilities, computer coordinators performed a wide variety of other tasks. They also served on technology committees and occasionally wrote grants relating to technology acquisition. In several instances, these respondents reported having responsibility for the allocation of money in their schools to purchase computing equipment and new software.

Whereas these respondents recognized that their positions enabled them to gain important recognition and experience for future jobs, possibly higher on the administrative ladder, many of the coordinators voiced frustrations with their jobs. They suggested, however, that these frustrations stemmed from their school climates rather than characteristics inherent to the job itself. Several of them indicated that they would probably seek lateral moves to leave their schools in the near future, but only one of them expressed an interest in returning to classroom teaching.

There were two instances in the data to suggest that the role of the coordinator as well as its occupational stability is still in the process of negotiation. In both instances, the schools downgraded their full-time coordination positions that had been filled by certified teachers to part-time positions to be filled by classified "aides." In one of these schools, the principal acted on her hunch that greater access to computing equipment would increase computer use among teachers. She "busted the lab" and distributed the computers equally to each classroom. Without a lab to manage, the principal believed that the school's money would be better spent on technical expertise rather than integrative resource coordination. Thus, the coordinator's position was downgraded from full-time to part-time.

A similar episode occurred in a second school. Although this school did not redistribute its computing equipment, the school board decided to redistribute financial allocations and reduced the coordinator's job to part-time. As a result, the coordinator left the school and the school hired a technical assistant without teaching certification to work in the lab part-time.

In both instances, the decision to reduce and redirect the focus of this position was made in a traditional top-down fashion rather than in a more democratic way. Moreover, in both schools, classroom teachers expressed grave misgivings about their ability to sustain satisfactory levels of computer use on their own, with only technical assistance. These two episodes raise concern over the future of the coordinator position as a viable means of occupational gain for teachers.

Promotion to Full-Time Administrative Positions

Two respondents in this study realized promotions to full-time administration in the years since my earlier interviews with them. At that time, both of these individuals demonstrated styles of computing marked by integration. Prior to their promotions, they both were actively involved with computer implementation in their schools and both held positions as computer coordinators.

The first case involved Mr. Martin, a 40-year-old employee of a private school who, prior to his promotion, divided his time between the positions of computer coordinator for his school, chair of the math department, and math teacher. After completing a master's degree in mathematics education several years ago, he was promoted to director of admissions for the school.

During our interview, this respondent reflected on the value of computer skills in his school. He explained, "Computer expertise gives you credibility and it gives you opportunities for funding." Credibility, he argued, accompanied computer skills because nonskilled persons attributed credibility to the skilled person.

> People think you've got an edge. They think you are the modern teacher when you use computers, and they think

> you're not if you don't. I don't really believe that I am better because I am able to use that thing [the computer] but others don't realize how easy it is to use so they think I am on the cutting edge.

Conversely, this respondent noted that teachers who avoided using computers did not have as much credibility. He said, "You don't have as much respect accorded to you when you don't use a computer. People sort of think that you are on a dead-end track, like 'Oh look, you are headed for nowhere.' "

In addition to enhancing one's credibility, Mr. Martin observed that, in his school, computing increased opportunities for funding. He stated, "To a large extent, anything that says 'computer' gets you money around here." He went on to explain, "As a department chair, you can do what you want if it involves computers. Also, we have Summer Grants available for teachers and anything that comes up with the word 'computer' is almost automatically approved." A classroom teacher in the school later concurred with this opinion, saying that in recent years she had received two different grants, both of which were for projects that involved computing.

Considering his own experience, Mr. Martin related his promotion in large part to his computer expertise. He stated, "My computer skills played an important part in the promotion that I received in a couple of ways." Making reference to his earlier argument regarding credibility, he made the following comment:

> The kids think that since you know computers, you know more. Parents often think what their kids think. The administrators reflect what parents think when they make decisions. So, I think it was easier for me to get this promotion because of my computer skills than had I been just a math department head who didn't know computers.

The second promotion in my sample involved Mrs. Lee, a 48-year-old coordinator who divided her time between a parochial elementary school and the central Catholic school office. When I interviewed her for this project, she revealed she had recently received a promotion to become the principal of a different parochial elementary school for the following school year.

As with Mr. Martin, this respondent readily acknowledged that she had gained credibility and respect in her school because of her contribution toward computer implementation. She was not, however, as quick to link opportunities for promotion to one's computer skills. She said, "I know people recognize and appreciate my computer expertise but I wouldn't say that if you didn't know how to use a computer that your chances for promotion would be negatively influenced." Then she suggested, "However, I do think that it is an issue that we need to begin addressing, particularly if we continue to place more emphasis on computing." Despite her reluctance to associate computing experience to her own occupational gains, while Mrs. Lee discussed her job as computer coordinator, it became apparent that the experiences she gained in that position probably played an important role in her promotion. As computer coordinator, she gained positive recognition, acquired valuable administrative experience, and established important contacts with other administrators, all of which are recognized as factors contributing to organizational advancement (Kanter, 1977).

Mrs. Lee's principal credited her with the development of an innovative computer plan for the school. He commented, "Yes, she's done a great job. And, although I've been extremely supportive all along, I made it clear from the beginning that she was responsible for all aspects of computer management in this school." As a computer coordinator, Mrs. Lee's responsibilities included ordering software and hardware, repairing equipment, providing professional development for teachers, and so forth. Moreover, she also was responsible for teacher supervision. For example, when asked if her principal monitored his faculty's use of computers, she responded, "Sure, but he normally never says anything to them. Instead, he'll tell me, 'You need to go set them straight,' or, 'You need to tell them they shouldn't be doing that.' I've become really thick-skinned when dealing with the faculty. It's been a great learning experience for me."

Both as school coordinator and district coordinator, Mrs. Lee gained important opportunities for recognition, established professional contacts, and actively networked with educators in other school administrations. For example, she provided school and district training sessions that brought her in contact with large numbers of teachers and administrators. At the broader level, she conducted a monthly support group for school computer coordinators throughout the district and recently had formed a five-member regional technology committee on which she served.

No Obvious Rewards

Of the individuals participating in the first phase of this study who had indicated strategies of integration or technical specialization, only one teacher, a 43-year-old second-grade teacher in a public school, showed no obvious signs of occupational gain since that time. This teacher held virtually the same classroom position and the same set of responsibilities in the same school. On interviewing her in the second phase of the study, it became apparent that, rather than continuing to engage in a stronger computing style over the last 4 years, she had lost interest in computers altogether.

The respondent admitted that although the use of computers among teachers did not appear to be rewarded in any way at her school, computing skills could, and probably did, have a positive impact on a teacher's status. She reported, "I think computing impresses our principal because she's real interested in a grant to expand computing that our school recently received and would like people to become more involved with it." Then she added, "And I'm sure if you're doing all this stuff it certainly looks better to her." Even though this teacher recognized computing as providing a potential source of gain, she reported that computing activities ranked lowest on her list of priorities for her classroom and that she deliberately had begun avoiding computing activities altogether when her school hired a computer coordinator.

Other Movement

On examining the experiences of teachers over time, it became clear that there were sharp distinctions in gains depending on the computing style of teachers. Whereas teachers who demonstrated stronger styles of computing overwhelmingly gained rewards over time, teachers engaging in avoidance strategies at the time of the second phase of this study experienced little occupational gain at all. One of the few teachers in this group who did advance, however, was a veteran first-grade teacher from the parochial system, who reported having been promoted to a part-time assistant principal. Along with the title, she gained a small increase in pay and increased responsibilities but reported that she still was fully responsible for teaching her first-grade class. She admitted that since our earlier interview, she had probably experienced a decline of computing skills. She attributed her regression to her lack of time, particularly in that she had become assistant principal, and to the fact that she now relinquished all of her computing responsibilities to her school's computer coordinator.

Of the remaining respondents who did not experience occupational gain over time, several had left teaching, because of either maternity leave or retirement. One teacher from a private school had left teaching and I was unable to locate her for continued participation in the study. In the interview, the principal from her school could not recall her or the circumstances under which she left. He indicated that his failure to picture her may be related to her unremarkable contributions in the school, particularly with regard to computing. He reported rather sarcastically, "I can't even remember her. If she had no computer skills, she's got no credibility, she has no virtue, she's out of here. Sorry, that's the way life is. No, I don't remember her at all."

Discussion

Computer technology created opportunities for educators in elementary schools to gain occupational rewards. Opportunities for gain were not available for all teachers, however. The evidence presented in this chapter reveals that teachers and computer coordinators engaging in stronger computing styles realized important rewards in their schools over time, whereas most other respondents did not.

An understanding of the occupational gains available to computer users in elementary schools can contribute to an emerging body of literature that examines the outcomes of technological innovation in the workplace. Recent studies concur that as organizations introduce new technology, opportunities for occupational advantages and rewards become available to workers. Technical expertise serves as a filter for occupational gains (Barley, 1988; Danziger, 1985; Disprete, 1988; Kraemer & King, 1986; Persell & Cookson, 1985; Walsh, 1989), and those workers with stronger skills will be rewarded for their innovative behavior. The rewards gained by teachers and coordinators in this study support this notion. They demonstrate a range of opportunities available to technically skilled educators. Occupational rewards involving increased recognition, status, and responsibilities were gained by technically competent educators in each school. Many of these teachers capitalized on that recognition to move horizontally into a school that they perceived to be more desirable or to move upward into a more specialized position. Whereas the strongest upward movement was from classroom teaching to computer coordination, recent evidence suggests that this position may have negative consequences as educators in this position scramble for full-time openings only to find themselves switched to part-time employment several years later. Finally, a few educators coupled their computer expertise with other experience to gain promotions into administration.

The findings presented here have important implications for elementary school teachers. Whereas traditionally teachers have had limited opportunity for rewards in their workplace, computers offer them a means with which they can better meet their own occupational goals by strengthening their position within their school or provide them a means to become more competitive in acquiring a new position elsewhere in the educational community. At this point it would be useful to examine the mobility and career paths of technically skilled users over a longer period of time to determine the conditions under which their acquisition of rewards either continues or declines. Given the rewards effectively gained by technically competent users, it also would be useful to examine responses of less technically competent users to determine whether they are likely to compete for the same rewards by further developing their computing expertise or whether they are more likely to opt out of competition, and in the process, computing altogether.

8

Guiding Schools Through Computer Integration

In this study, I have focused on the occupational dynamics that evolved over 8 years as elementary schools in one large metropolitan area implemented change with computer technology. Computer implementation is a process occurring over time, and the systematic examination of this process longitudinally has produced important findings related to structural and occupational dimensions of technical change in elementary schools. Moreover, these findings have important implications for education at the elementary level.

This chapter provides an overview of educators' experiences in the process of change by summarizing three styles of computing among teachers. It then discusses the contribution of that understanding for a more comprehensive model of technical change with computers and teaching. It also considers the value of an integrative computing style in addressing the educational concerns of policymakers and needs of students. The chapter concludes with a guideline for educators to use when devising an effective, integrative program of computer implementation for their schools.

Three Styles of Computing

Teachers in this study created and sustained three styles of computing in the process of computer implementation. Over time, these styles became routinized in the schools; that is, the styles persisted despite the acquisition of additional computing equipment, increased familiarity, or ongoing training and experience with computers. Each of these computing styles satisfied the expectations that schools and local school communities held regarding computer use, yet the three styles had different outcomes for teachers both in short-term concerns and long-term occupational effects.

The most predominant style of computing among teachers was that of avoidance. Teachers engaging in this style of computing typically created and participated in strategies that distanced them from computers and otherwise reduced the amount of time they spent attending to computer-related activities. Through their strategies, the teachers facilitated computer experiences for their students that commonly involved limited and repetitive use of software intended for drill and practice or word processing. Generally, though, these teachers sustained a low level of computer use themselves and low levels of interaction with students while they worked with the computers.

Resulting from limited involvement with computers and strategies that effectively distanced them from the technology, the teachers who routinely engaged in avoidance sustained negative effects of computers on their jobs, the most salient of which were increased risk taking and task displacement. The negative effects discouraged these teachers from further developing technical competence with computers or expanding their use of computers to include more varied or creative applications. Many of these teachers continued to avoid computing and relinquished most of their computer-related responsibilities as their schools hired computer coordinators. Avoidance strategies also created barriers to occupational rewards and other gains, such as increased status and autonomy and, with few exceptions, the occupational positions of teachers who continued to avoid computing remained status quo over the 4 years.

Another style of computing significant to this study was integration. Teachers engaging in this computing style generally embraced computers and viewed the technological change as a challenge or an opportunity to gain new experiences. These teachers were instrumental in promoting computing in their schools through management and instructional activities for both teachers and students. These teachers generally integrated the technology into their teaching methods and curriculum, their workday, and the learning experiences of students. They selected drill-and-practice software based on curricular goals and the needs of their students. In addition, they introduced a broader range of computer applications and developed creative and engaging projects that integrated computer activities with more normal instruction. Positive effects of computers were most salient for teachers who employed integrative strategies, particularly those relating to the use of the computer as a teaching tool. When used in that capacity, computers enriched the more regular curriculum and enhanced teaching skills, including the ability to assess students' progress in areas of learning or skill development and to provide individual instruction. Computers also revitalized teaching, bringing a sense of excitement and enthusiasm to the instructional setting. Teachers found these features of computing to be intrinsically rewarding. In addition to intrinsic rewards, however, teachers demonstrating an integrative computing style also gained occupational rewards ranging from increased status and power in their schools to promotions involving full-time administrative positions.

Technical specialization was a third style of computing. As in integration, teachers engaging in this computing style embraced computers and viewed the technology as a challenge. These teachers promoted computing in their schools and their activities relating to computing typically demonstrated strong teaching methods, such as consistent scheduling, preparation, and delivery of planned lessons involving the computer. During instructional sessions, however, they generally employed the computer as an object of teaching rather than as a means of supplementing the more regular curriculum. They focused their efforts on teaching students about the technical aspects of the computer, such as parts of the machine; technical skills, such as keyboarding; or teaching elementary levels of computer science, such as flowcharting. As they related to these teaching objectives, computers enhanced the teaching skills of technical specialists, including their ability to assess student progress in areas of learning or skill development and to provide individual instruction. Whereas teachers engaging in this style of computing found computers to be intrinsically rewarding, based on my observations, it appeared that students were less likely to find computer applications associated with this style interesting, exciting, or relevant. Schools commonly valued these teachers for their technical ability, especially with regard to machine selection, maintenance, and repair. Consequently, these teachers also gained occupational rewards ranging from increased status and power in their schools to promotions involving positions of computer coordination.

Toward a Theory of Technical Change and Teaching

The ethnographic data used in this study, drawn from extensive interview and field observation at two different points in time, provided information that goes beyond previous, mostly cross-sectional survey data to increase our understanding of the process of computer implementation in elementary schools. By examining the effects of that process on the work culture of teachers, the study also provides an explanation regarding the ways and degree to which computers are integrated into the instructional setting.

In the beginning of this book, I contended that arguments based on organizational or occupational models alone do not adequately explain the experiences of schools and teachers in the process of computer implementation in that setting. A perspective of change framed in the organizational literature, for example, contributes to an understanding of computer use among teachers in schools, but because it does not consider the effects of computer technology on the occupational culture of teachers, it provides an incomplete explanation of technical change and teaching. This perspective, however, contributes understanding of the process by defining schools as institutional organizations (Hannaway, 1993; Meyer & Rowan, 1977) and also by reinforcing the notion held by Weick (1976) and others that administrative arrangements in schools are loosely coupled with teaching.

Consistent with these arguments, this study identified structural factors in the process of innovation, including the flow of technical change, goals, management, staff development, and incentives for change, that loosely defined and structured the process of computer implementation in schools. On the basis of these factors, it appeared that organizational factors failed to establish the relevancy of computers for teachers. Relevancy was a recurring theme throughout the study. Perhaps because the origination of the flow of technical change was outside the schools, the process of change lacked meaningful goals, there were problems associated with staff development, or for other reasons, many teachers and principals in this study did not perceive computers as a technology relevant to their jobs. Instead, most of them viewed computing activities as an irrelevant, additional chore to their daily routines and tasks as educators.

It is commonly recognized that the organizational arrangements characterizing most schools heighten the autonomy and discretion of teachers. This has led some researchers who have found low levels of innovative behavior in schools to suggest that teachers rely on their occupational autonomy to ignore change (Cohen, 1987; Cuban, 1986; Hanson, 1981).

On the other hand, much of the previous occupational literature pertaining to the introduction of new technology in other occupations has undervalued the significance of worker autonomy in shaping the process of technical change.

In contrast to either of these perspectives, this study revealed that when computers were introduced in elementary schools, teachers relied on their workplace autonomy to address their own concerns while simultaneously shaping and defining technical change. For example, one such concern that teachers repeatedly grappled with involved a fundamental characteristic of autonomy—their discretionary use of time. Time is a precious commodity to teachers and in this study, teachers differed in the ways that they managed their time, both personally and professionally. Whereas most teachers and administrators distanced themselves from computers and used computer time as a "buffer" to their more immediate teaching routines, other teachers, specifically those who embraced computer technology and perceived it as relevant to their jobs more willingly rearranged their daily teaching routines, forfeited planning time, extended their work day, or otherwise built time into their schedules to further their own knowledge and experience with computers and to assist others (students and teachers) with opportunities to learn and gain computing experiences.

Relying on their autonomy, teachers in this study did not respond uniformly to change with computers but developed three styles of computing that satisfied their own concerns as well as the expectations of the schools. These findings relating to the autonomy of teachers and their styles of computing are critical to the theoretical significance of this research and are consistent with the arguments of Lipsky (1980), Barley (1988), Hodson (1991a), Levin (1987), and others who maintain that workers engage in the social construction of their workplace. They produce autonomous behaviors that meet their own individuals concerns and interests as well as those of the organization.

Previous studies suggest that new technology disrupts jobs, job skills, and other aspects of work. The experiences of teachers with the implementation of computers support the notion that new technology will disrupt traditional workplace dynamics by affecting work expectations, concerns, skills, roles, and rewards. Whether teachers perceived the disrupting effects of computing as positive or negative, however, was related to their styles of computing. Whereas elementary school teachers historically have worked in an environment marked with homogeneous skills and a relatively flat occupational reward structure, computer technology created opportunities for some teachers to gain important skills and other positive effects, including occupational rewards, depending on their style of computing. That the three styles of computing led to different occupational experiences and outcomes for teachers explains, in part, the relative consistency of computing styles in and across schools over time, even when schools reinforced organizational or occupational support for computing through the provision of additional computing equipment, staff development, or other measures, such as the employment of computer coordinators.

Although this study was based on the experiences of 13 elementary schools in the process of computer implementation, the findings it produced provide support for the contention that a comprehensive model of computer technology and teaching will consider the structural, occupational, and other contextual factors that contribute to the process of change in the educational setting. The study also raises interesting questions pertaining to the relationship of certain factors, such as characteristics of teachers to their various styles of computing. For example, one cannot help but wonder whether a teacher's age or gender were related to a particular style of computing. Contrary to the popular opinion that age and computing were probably related, my observations did not support such a notion. On the contrary, teachers of all ages and years of teaching experience engaged in each of the three styles of computing. This finding is supported by other studies in which age was not found to be a factor related to attitudes about computing or computing practices (Becker, 1993; Pelgrum, 1993).

An indication of a relationship between gender and style of computing, on the other hand, was prominent. Whereas most of the women who participated in the study engaged in computing styles characteristic of either avoidance or integration, nearly all the men engaged in technical specialization. Although this finding was constrained by the small number of men who participated in the study, it nevertheless is consistent with other studies that reveal gender differences in attitudes toward computing (Pelgrum, 1993), computing skills (Lewis, 1987), and patterns of computing (Lewis, 1987; Turkel, 1984). Lewis (1987) argues, for example, that men tend to approach computers in a technical fashion, whereas women are more apt to approach computers in a humanistic manner, using the equipment as a productive tool in their work and incorporating it into cooperative activities.

Although the identification of specific relationships such as computing styles and characteristics of teachers would be useful, the nature, intent, and scope of this study precluded a rigorous examination of such relationships. Nevertheless, findings presented in this book clearly inform and encourage such investigation. They also promote consideration of the value of computer integration over other styles of computing in the elementary school setting.

Integration and Education

One of the most appealing qualities of computer technology for schools is its flexibility and the wide range of possibilities it offers in the educational arena. These possibilities depend not only on characteristics of computers themselves but also on how they are applied in the instructional setting. As this study indicated, computer strategies diverged dramatically from one computing style to another. Teachers engaging in integration varied computer activities for students and applied software to include a broad range of subject matters and to target and address individual student learning needs. They also developed cooperative and creative projects for students involving computers. On the contrary, teachers engaging in avoidance employed computers in routine ways, using them to reinforce concepts for a limited number of subjects or for word processing, and technical specialists employed computers primarily as objects of study, focusing on issues of computer science or specific technical skills such as keyboarding.

Whereas this study found that notable opportunities for occupational rewards among teachers were related to integration and technical specialization, the three styles of computing demonstrated by teachers in elementary schools raises the question as to which of these will best meet the goals of policymakers and needs of students in the longer term. Although this study did not examine this issue specifically, it became clear to me after having observed the use of computers in schools over the span of 4 or more years, that a style of integration is perhaps the strongest and most relevant style of computing for the elementary school setting.

Studies examining the relationship between computers and educational performance reveal that computers have had limited effects on traditional measures of educational performance outcomes such as standardized tests (Becker, 1991). Based on findings from this study regarding the computing styles of teachers, it seems likely that educational performance outcomes may vary depending on the effects of computer applications associated with different computing styles. For instance, there is no reason to expect student performance on standardized tests to improve or decline because of computer applications that focus primarily on keyboarding or other technical skills provided characteristically by technical specialists. Similarly, computer applications most commonly provided by teachers engaging in avoidance, which focus on routine and arbitrary drill-and-practice exercises, are not likely to have a significant effect on performance measures. It is likely, however, that performance on standardized tests may improve when teachers employ drill-and-practice routines to target individual areas of weakness among students and then reinforce those with teaching strategies that include more personalized instruction. These strategies are characteristic of an integrative style of computing.

It is also likely that computers in elementary education can speak to the future needs of students when strategically applied with integrative strategies. Researchers examining the role of educational technology in preparing students to meet future workplace requirements argue that schools can best prepare students to meet the challenges and demands of the ever changing workplace by developing skills that are flexible and adaptable rather than highly specific and technically based. Levin and Rumberger (1986) suggest that those individuals most strongly positioned to meet future workplace demands will be those who demonstrate a variety of strengths including skills in literacy, communication, logic and reasoning, and broad technological applications. Murnane (1988) and Grubb (1989) concur, predicting that future demands of education will include the development of creativity, higher level and abstract thinking skills, and the ability to cope with change. These sets of skills provide students a fundamental base from which to learn new job-specific skills. But they also stimulate the ability for future workers to more fully participate in problem solving and decision making, and thus become proactive in shaping, rather than passively enduring, their own future workplace outcomes.

The computer applications devised and used by teachers engaging in integration are best suited to the future needs of students. This computing style was flexible and nonrestrictive. Teachers used integrative computer strategies to challenge and guide students with stimulating, creative computer-related projects that often depended on and enhanced the cooperative problem-solving and interpretive skills of students. Because integration engages students in the learning process, reinforces student interaction and collaborative strategies, and emphasizes technology as a tool for learning and teaching, it is likely that this style of computing will best meet the future needs of students. Clearly, the effects of integration on educational performance and longer-term educational outcomes for students are areas of research that warrant closer examination.

Guidelines for Educators

The findings presented in this study have important implications regarding effective computer implementation in schools. The research points to concrete steps that educators might take to establish or refine a computer program in the elementary school setting.

Goal Setting. A strong program of computer implementation will promote a democratic working climate whereby educators share and participate in goal development. With input from the broader school community—including students, parents, and business linkages—teachers and administrators should set long-range goals regarding strategies of computer implementation that are relevant, reasonable, clearly understood, and make effective use of resources. Importantly, these goals should be consistent with curricular goals set at the state, district, and local school levels. Following that, educators should articulate and define short-term objectives and expectations that reinforce long-range goals. Effective long range-goals as well as short-term objectives of computer implementation, targeted by teachers, principals, and other users, will establish and then reinforce the relevancy of computing in the context of elementary education.

Principal Leadership. Principal leadership is critical to successful computer implementation. Principals must be proactive rather than passive in the process of technical change and avoid becoming overly dependent on other individuals such as technology champions among the faculty or a computer coordinator to promote computing in their schools. Principals should familiarize themselves with the strategies characterizing the three styles of computing and actively encourage teachers to practice that style that best reflects more general computing goals of the school. Furthermore, principals cannot expect teachers to use a technology that they themselves are unwilling to use. By integrating the use of computers to complement regular administrative, instructional, or personal objectives, principals will demonstrate to their faculties their commitment to computer implementation, increase their familiarity and knowledge about computers, and be better positioned to make effective decisions regarding computer implementation in their schools.

Management Committees. Strong programs of computer implementation depend on effective management of appropriate activities related to computing. Whereas management committees or teams undoubtedly serve an integral function in the process of technological change, they should be staffed on a staggered, rotating basis so as to include veteran enthusiasts but also provide spaces for more novice computer users. This will encourage more players to take ownership in the ongoing process of change rather than promoting territorial claims by those individuals who acquire relevant technological skills early on.

Equipment Needs. Schools must examine and assess their equipment needs with an eye toward maximizing the constructive use of computing resources. Whereas stockpiling computing equipment may increase computer availability and accessibility, it does not guarantee effective computer use among teachers. Importantly, schools must commit requisite financial investments to sustain the maintenance of machines, ongoing acquisition of software that best addresses curricular goals, and purchase of new equipment when deemed necessary or advantageous. Whether equipment needs call for a one-time expenditure or a more permanent redistribution of financial resources, this is an issue that will benefit greatly from discussion and communication among educators and community participants, such as parents or business linkages, to ensure consistency between curricular and implementational computing goals, financial and computing resources, and computing applications.

Staff Development. Staff development is essential in the computer implementation process. Programs of training, tutoring, and curricular guidance involving computer applications should emphasize and reinforce the use of the technology in addressing the needs and interests of users, both educators and students alike. Following this, schools should recognize the value of creative experimentation with new equipment and software, and devise opportunities for educators to develop, practice, and refine curriculum instruction involving computing strategies.

Opportunities for staff development should be available in ways that minimize encroachment on the personal time of teachers.

Integration. Though not all teachers will respond uniformly to computer implementation, staff development efforts can promote a stronger computing style, such as integration, among teachers by recognizing the broader range of strategies characterizing this style rather than concentrating exclusively on overt computer applications in schools. In keeping with that fundamental goal, training and leadership efforts must encourage users to capitalize on integrative strategies such as those demonstrated by teachers in this study. For example, teachers should be encouraged to go beyond the consistent reservation of equipment to its consistent use. They should be encouraged to schedule and apply computing activities within the context of their more regular curricular agenda rather than as an itinerant activity. To maximize learning opportunities with computers, teachers should be encouraged to plan, manage, and reinforce computer activities as they would their other lessons, and to establish learning centers, previewing new software and preparing students accordingly. When teachers employ drill-and-practice routines, they should do so in ways that address the individual needs of students, as well as the performance needs of the school. Teachers should be encouraged to vary computer applications to include a broader range of computing activities designed to expand and enhance more regular classroom curriculum. Finally, teachers should be encouraged to capitalize on the opportunities afforded to them while students work on computer activities individually or cooperatively to instruct them on a more individual basis and monitor their progress and individual learning needs.

Incentive Programs. Schools should develop strong incentive programs involving practices of evaluation and reward for purposes of both motivation and reinforcement. If teachers contribute toward the development of computing objectives, are aware of explicit expectations regarding computing toward which they can direct their computing efforts and activities, and are held accountable for moving toward those expectations, their motivation to use computers is likely to increase. Furthermore, efforts toward innovative behavior among teachers is deserving of extrinsic reward. These rewards need not be particularly costly for the school. Ideally, though, the rewards should be linked to the new technology itself and reinforce continued innovative, creative behavior. For example, schools could reward exemplary teachers or teams of teachers with new computing equipment or software packages, registration for a technology conference or seminar, or a class field trip to a nearby workplace that demonstrates interesting applications of computer technology, or arrange for a deserving teacher to get an additional planning period for a day or longer.

Coordination. Computer coordinators play a significant role in the development of an effective, integrative computer program in elementary schools. Coordinators often work, however, under difficult conditions. When schools employ coordinators, they should be aware of the following:

Resource coordination: Schools will enhance integrative computer programs by employing computer coordinators as resource facilitators, using their expertise to identify and access technical resources and coordinate strategies of computer integration *with* classroom teachers rather than *for* them. When educators perceive computer coordinators as computer "teachers" rather than computer resource coordinators they are reinforcing the notion that coordinators, alone, are responsible for instruction involving computer applications. This notion particularly is reinforced when teachers gain planning time while their students work with the computer coordinator. In this instance, teachers most likely will avoid computing in favor of other activities. Even when classroom teachers are required to stay with their students while they work on computing activities, if the school employs a computer teacher, classroom teachers will be likely to take a back seat in computer instruction.

Full-time employment: Full-time resource coordination is more effective that part-time coordination. A full-time coordinator has greater potential for creating and delivering a consistent program. This person should be willing and able to promote a style of computing consistent with the computing goals of the school. For example, if schools are committed to an integrated computer program they should hire a coordinator who demonstrates an integrative style of computing.

Job description: Coordinators should work within a clearly defined and delineated position. Moreover, faculty should be knowledgeable of this description to dispel expectations for the fulfillment of responsibilities, tasks, and favors that fall outside the realm of the defined job. This will increase the understanding of the role of the computer coordinator among faculty and administration, and reduce or eliminate the possibility of excessive personal favors from becoming expected behavior.

Computer coordination is a shared activity: A computer coordinator, whether full-time or part-time, must not be solely responsible for computer integration. Computer coordination requires shared responsibility, cooperation, and an investment of time and effort from all parties involved, including administrators, classroom teachers, and coordinators.

Communication: Coordinators should have access to and be expected to participate regularly through formal channels of communication with administrators and faculty within the school, and fellow coordinators across schools. By participating in general faculty gatherings they will become more a part of the school community and by participating in team meetings held with classroom teachers, they will increase the possibility of a coordinated, integrative computer program. Periodic meetings and other forms of communication with colleagues across schools will provide opportunities for group support and exchange of ideas, strategies, and resources.

Monitor the Concerns of Computer Users. An effective program will provide a means of monitoring and addressing the concerns of users regarding various aspects of the technology or the implementation process more generally. Although some concerns may be highly individualized, others may appear as patterns among teachers and be associated with either latent effects of computer technology or implementational strategies. In either case, these should be recognized as areas of concern deserving of further attention for problem solving.

Reevaluate Computer Programs Periodically. Finally, the ongoing dynamics of technical change and implementation in schools demands that a program provide for the reevaluation and periodic review of the process. Occasionally, these reviews will call for certain alterations in the implementation program. Whereas these programs will benefit from periodic review, subsequent modification, and refinement, educators must recognize the interdependence among features of implementation and that changes in one aspect of the program are likely to create the need for change in other areas. For example, educators may reconsider the debate between centralizing their computing equipment in computer labs or distributing it to individual classrooms. If schools begin redistributing their technical resources, they must recognize that, although the computing equipment remains relatively the same whether it is in a computer lab or in the classroom, its relocation will create changes in the ways that will be used for instruction and learning. This, in turn, will require additional training and support among classroom teachers.

As local and state educational systems continue to acquire computers and other instructional technologies for their schools, I am hopeful that the insights and understandings presented in this book will encourage and enable policymakers, managers of technological change in schools and school districts, administrators, teachers, and other educators to become more active in accessing and applying relevant knowledge in the process. Their broader based participation and informed decision making undoubtedly will enhance the workplace experiences of educators and, in turn, the provision of quality educational opportunities for students.

Appendix

Research Methodology

I collected the data for this project in response to the need to expand the depth of research pertaining to computer implementation in elementary schools to the qualitative level, and with the aim of gaining a detailed understanding of the work world of elementary school teachers throughout the process of change with computers. This appendix presents an overview of the ethnographic methods I used during the study that was conducted in two phases spanning 4 years. The first phase was conducted at least 4 years after each of the participating schools had acquired computers and the second phase 4 years later, so that at the time of the second phase, each of the participating schools had had computer equipment for at least 8 years.

The project was designed to examine a basic set of theoretical arguments regarding structural and occupational dynamics and the implementation of computer technology in elementary schools. Accordingly, the issues were examined systematically through observation and collection of both casual and formal accounts from teachers and other decision makers in the schools.

Site

The study took place in elementary schools located in one county of a large metropolitan area of nearly 1 million people in Kentucky. At the time of the first phase of the study, the population of the county proper was approximately 678,000, with a total school enrollment of almost 120,000 students in nearly 250 public, private, and parochial schools.

The public school system employed teachers in 88 elementary schools (Grades K-5) serving roughly 42,500 students. The system was merged and desegregated in 1974. Its schools offered a range of educational programs at the elementary level, including regular, traditional, advanced, and one school focusing on self-directed learning. The system was centrally organized with the central board directing decisions pertaining to staffing, curriculum standards, and budgeting. At the time of the first phase of the study, the public system had recently begun an experimental program of participatory management on a limited basis, which attempted to move decision making to the lowest possible level. Teachers, as well as principals, had a voice in policy decisions as they applied to their own schools, and in that way, played a significant role in school management. After the enactment of the Kentucky Education Reform Act (KERA), site-based management through school councils was extended to all public schools throughout the state.

When the study began, the county's parochial system employed about 720 full-time and part-time teachers in 56 elementary schools (Grades K-8), with a total enrollment of nearly 14,600 students. There was a central Catholic school office, but compared to the public school system, the individual schools in the parochial system operated more autonomously. For instance, principals, in conjunction with their individual parish school boards, hired and fired personnel, set budgets, and determined many policies that directly affected their schools.

Finally, there were about 25 independently run private schools offering elementary education in the county. These schools typically fell into one of two categories: (a) those that were well-established elite schools and (b) those that originated in the 1970s in response to the county's public school desegregation plan of 1974. In either case, the private schools operated independently, each with its own school board, budget, curriculum, and so forth.

The county's public elementary schools began acquiring their first wave of computers in 1984 and by 1986 every school had a lab of 32 computers, one for each student in any given class, and these were networked into a central system providing easy access to a wide variety of software programs. At that time the board of education established a *computer support unit* that served educators in public schools throughout the district. Parochial and private schools obtained computers much less systematically than the public system, and although most of these schools had computer labs, the ratio of students to machines in the labs ranged from 1:1 to 3:1. None of the computers in these schools were networked, and users depended on floppy disks to access software programs. Although there was a part-time computer coordinator at the Catholic school office, individual schools in the system were responsible for acquiring computer equipment for themselves. The predominant type of computer in all the county's elementary schools at the time of the first phase of this study was Apple II and remained so at the time of the second phase.

Sampling

Nine schools (four public, three parochial, and two private) participated in the first phase of the study. These schools represented a little more than 5% of the total number of elementary schools in the county. I selected schools for the study to reflect the county's full range of teaching environments at the elementary level. To do this, I used a sampling grid in my selection process similar to one used by the public school system for in-house research. The grid ensured representativeness in the selection of schools with regard to (a) programs offered (i.e., regular, traditional, advanced), (b) desegregation status (i.e., schools designated as exempt from busing, head-of-cluster, or cluster schools), and (c) geographical distribution (inner city, suburban).

Of the four public schools that participated (a fifth school declined to participate because of scheduling conflicts) one offered a traditional program and the other three offered regular and advanced programs. Two of those schools were exempt from busing, one was a cluster school, and the other was a head-of-cluster school. Those schools, along with the five parochial and private schools that participated in the study, were geographically distributed, with four located in the city and the others in various suburban areas. Each of the schools enrolled between 350 and 400 students and employed 20 to 26 teachers. Class sizes in the schools ranged from 15 to 32 students, with the larger classes found in the public schools.

Gaining Entry to Schools

At first glance, it would appear that schools operate on regular schedules, but in reality, a "regular week" for an elementary school seemed to be an exception rather than the rule. There are holidays, schedule changes, field trips, and maintenance tasks that constantly challenge the normal routine. For this reason, I decided to set up my schedule of visitation to each school no more than two weeks in advance.

To gain access to public schools, I obtained a co-signed letter of introduction from the board of education. The letter stated the nature of the project and the board's consent to cooperate with me. For reasons of validity, the letter was worded carefully so that administrators would not misconstrue or misunderstand the intent of my study or my relationship with the board. Because of their relative autonomy, however, I only had to contact principals or headmasters of parochial and private schools to gain entry to their institutions.

Initial contact with principals was made by phone. Typically I introduced myself and explained a little bit about the project, my methods, and my sponsorship. Though I was prepared and willing to provide more extensive details regarding the project should the need arise, I did not volunteer the information so as to avoid the possibility of discouraging principals from participating by making the project sound overwhelming. Instead, I emphasized my interest in their computer program and that their school's participation was very important to the overall success of the project. This approach proved very successful. It seemed as though any study that promised to examine computers in schools, regardless of focus, would be welcomed.

On entering each school, I initially met briefly with the principal, who then typically showed me the school's computer lab and other computing facilities. In every case, after that person's questions were satisfied, I was given complete access to the school and could come and go as I pleased. During this initial meeting, I obtained copies of computer lab schedules (if they existed) and, based on that, targeted teachers to observe, depending on the grade level of their classes and variation in time of day and day of week that sessions were scheduled.

During the first couple of days in each school, I informally observed in classrooms and computers labs and talked with principals and teachers about their computing patterns and concerns regarding the computers. I used these first few days to acclimate myself to the school and establish my status as a researcher. For example, as I met teachers, I always emphasized that I was observing rather than evaluating, and that I needed their help to succeed in my project. Corsaro (1985) notes that throughout his research at a nursery school, he frequently involved school personnel in the planning of data collection and analysis. This increased teacher satisfaction with his presence in the school and enhanced the overall effort. I used this strategy and felt I gained acceptance and rapport with educators more rapidly by doing so.

Early on in the first phase of the study, I realized that almost all the people I talked with seemed insecure about computers. I frequently found myself trying to dispel the misconception among teachers and principals that I was some sort of computer "expert" in that I was studying computer issues. Nevertheless, individuals did not hesitate to ask me my opinions or assistance with software and hardware problems they encountered and I usually evaded those questions if at all possible.

I also found myself actively countering the impression that I was an evaluator with authority. Teachers frequently are observed by administrative evaluators. I did not want to be misconstrued as one of these evaluators. Nor did I want my presence to intimidate teachers. Becker (1970) warns that subjects may feel threatened if they think a researcher's status is higher than their own, or if the researcher perceives her or his own work to be superior or overly important. Certainly, that could distort behavior and interaction. Teachers were quite willing to talk with me after they realized I was not a representative from some assessment team.

Finally, I usually let it be known that I had been a classroom teacher at one time. Not only did my previous classroom teaching experience enable me to anticipate characteristics in the instructional setting and anxieties of teachers but it also lent credibility to my endeavor. Teachers would often make comments such as "Well, you know what it's like," or "Having been a teacher, I'm sure you can understand."

Clearly, then, the research procedures were overt. Because of the restricted time that I would be at each school, it seemed that I was not able to develop strong ties with any of the participants. Gold warns of potential reliability problems with this type of research, "Because the observer contact with an informant is so brief and perhaps superficial, (s)he is more likely than others to misunderstand the informant and to be misunderstood by him (quoted in Cicourel, 1964, p. 44). Consequently, I attempted to interact with the school participants as much as possible to avoid misconceptions. At every opportunity, I conversed with teachers. I felt they would be more satisfied and comfortable in sharing information with me if they knew something about me and my research interests. In choosing to conduct the research overtly, teachers felt they had some influence over the proceedings. That, in turn, enabled me to gain teacher approval, support, and cooperation.

Observation

In each school, after familiarizing myself with the setting during the first several days, I spent approximately 15 hours over the next 2 weeks observing in classrooms, computer labs, lounges, cafeterias, and hallways. I terminated observation in each school when I believed that the data were reaching a saturation point, that is, that the observations were repetitious and providing no particularly new additional insight or information. Altogether, I observed 72 teachers as they conducted computing sessions in the labs of their schools. During this time I was particularly attuned to (a) patterns of computer use, (b) management of and control of computer use, and (c) general attitudes of teachers and other users toward computer applications in schools. These observations enabled me to address the ways that computer technology was managed and used in the schools. In addition, I was able to compare the relative computing patterns and other teaching strategies among teachers.

When I observed in labs, I always introduced myself as teachers entered the room and asked their permission to stay and observe. During the start of a class I would sit at a vacant table or desk and watch. Children seldom paid any attention to me at all, probably because they were accustomed to having adult visitors and were usually engrossed in activities such as operating the computer, listening to the teacher, or talking to peers. As the sessions progressed, I was able to record notes in a small notebook, roam the room, and talk with students about their computer assignments. Frequently, as students worked on the computers, their teachers approached me and began talking. During that time, I was able to establish rapport with teachers and get a sense of their working climate. In addition, I was able to establish contacts for subsequent interviews.

Interviewing

After I finished observing in each school, I returned to the school several times over the next couple of days to conduct formal unstructured interviews with teachers and other decision makers such as the principal and computer coordinator. During the first phase of the study, respondents were selected based on their likelihood to possess, relate, and clarify general levels of information, in addition to personal experiences, regarding computer implementation in their schools. Of course, interviews also depended on the willingness of the respondent to participate. This was not an issue, however, because every teacher I approached agreed to be interviewed.

Half, or 36, of the teachers I observed conducting sessions in computer labs participated in interviews, each of which was audiotaped and lasted approximately 1 hour. In addition to these respondents, some of whom functioned as their school's computer coordinator, I interviewed the principal in each of the schools, for a total of 45 formal interviews altogether. Twenty respondents were from the public schools, 14 from the parochial system, and 11 from the private schools. The respondents ranged from 23 to 72 years of age, with a mean age of 41 for the respondents from the public system, 42 for parochial school respondents, and 42.4 for the respondents from the private schools. Not surprisingly, the majority of teachers were female. There were six men in the sample, five of whom held positions of authority either as administrators or as computer coordinators. Whereas inexperienced teachers participated in the study, the mean number of years of teaching experience was 16.0 for the public school teachers, 14.1 for the parochial school respondents, and 13.3 for the private school respondents. Although at the time of the first phase of the study all the teachers and one principal reportedly had working experience with computers, less than one fourth of the total sample, or 10 respondents, indicated they had had limited training or experience with computers prior to the time they were introduced into their schools.

The unstructured interview offers the researcher the opportunity to gain complete information from the respondent because the respondent is encouraged to elaborate and provide additional description when appropriate. The general format of the interviews used "funnel questions" (Gordon, 1980) to acquire general and then more specific information regarding professional responsibilities, working routines, and teaching patterns. I sequenced the questions to maximize the acquisition of information as well as the flow of the interview process.

Among the issues that respondents were asked to describe were (a) the skills and processes that comprised their understanding of the role of teacher and how computer technology had been included or excluded in that role; (b) the ways in which computer technology had been implemented into their schools; (c) how the technology had been incorporated into their own work agenda and, importantly, why; and (d) the optimal uses of the technology in the elementary school setting. The questions were designed to require reflection and promote integration of the issues discussed throughout the interview.

Unless the respondent had a lengthy planning period, the interviews were conducted after school hours. That was preferable in that the respondent did not feel as rushed and could give undivided attention to the interview. All the interviews took place in the schools and were held in offices, classrooms, lounges, or the computer labs. These locations were convenient for the respondents and also allowed me to gain information about their working patterns in their natural work setting. Occasionally interviews were interrupted by students, intercom announcements, or other teachers. Usually, if other teachers inadvertently interrupted an interview, they exited quickly and apologetically. Once in a while, though, having overheard bits of the conversation, these teachers informally joined the interview. These occasions actually enriched the data because teachers would discuss and elaborate on each other's experiences and perceptions regarding computers.

I typically scheduled an interview with the school principal after the majority of other interviews at a given school were completed. Gaining an understanding of the working environment and program of computer implementation in a school prior to interviewing the principal gave me the opportunity to use those sessions to gain new information but also verify information that I had already collected. Finally, interviewing the principal last or close to last provided closure to my presence at the school. Oftentimes, after our interview concluded, the principal asked questions of me regarding my opinion of how his or her school compared to other schools, especially with regard to computer implementation.

Respondents were not asked to review the transcription data from their interview sessions routinely, but occasionally they were recontacted to elaborate on responses that I found to be vague or incomplete. In addition, respondents were encouraged to contact me at a later time in the event that on reflection they wished to amend or supplement their earlier responses with additional information. Occasions such as these arose several times throughout the study.

Phase 2

The second phase of the study was conducted similar to the first. I returned to seven of the original nine schools that had retained the greatest number of respondents from the first phase of the study. Then, in instances in which previous respondents from those seven schools had transferred schools since the first phase of the study, I went to their new school and consequently added four schools to the study.

The observation portion of this phase was more concentrated than in the first phase because I targeted classes and lab sessions based primarily on my earlier findings. I interviewed the same panel of respondents that I had interviewed previously and added respondents from the schools new to my study. The interviews were conducted in much the same way as they had been in the first phase but began differently because in the majority of cases I reviewed the respondent's previous interview from 4 years earlier before initiating the new interview. In those instances, I began the new interviews by reminding the respondents of comments they had made earlier that pertained to their future expectations or visions of computing in their schools. Sometimes their predictions were close to reality, and in other instances, they sounded far-fetched. In any case, the respondent's earlier predictions served as a great beginning point for a new interview. Respondents seemed to appreciate that I remembered them and their earlier contributions to the study and that helped to reestablish rapport with these participants.

Focusing on the period of 4 years since the earlier phase, this portion of the study addressed general changes in schools pertaining to computer implementation, issues of consistency and relevancy of computing styles among teachers, and occupational outcomes relating to computing styles.

Analysis

The ethnographic methods used in this study provided a means to generate analytic categories and explore the complex relationships between categories (McCracken, 1988). Throughout both phases of the study, I reviewed and coded the field notes and interview transcripts on a continual basis, employing the principle of constant comparison, whereby the most recent observations and interview responses were compared with previously collected data in search for similarities, differences, and negative cases. The data first were coded to distinguish general orientations to computing held by participants. I then identified various individual behaviors and later patterns of behaviors or strategies employed by participants that helped them to reinforce or sustain their general orientation to computing. Finally, I identified theoretical categories involving computing styles and other outcomes. Glaser and Straus (1967) suggest that the comparison and contrast of many cases will lead to a general level of analytic categories and their properties. The ongoing method of joint data collection and analysis highlighted the differences and similarities from one group to the next and, in that way, more fully developed each category.

Issues of Reliability and Validity

Methods of fieldwork encourage a researcher to be flexible and responsive to the social setting, which often raises questions of reliability (Becker, 1970; Glaser & Straus, 1967). Becker (1970) points out, for instance, that two researchers may study the same organization but describe it differently depending on their own interests and observations. The absence of hard and fast formal rules of data collection promote the valuable insight of the social setting so unique to fieldwork.

Systematic data collection enhances reliability. Thus, I documented the significant decisions guiding the collection effort. I carefully defined my methods and reassessed them periodically throughout both phases of the study. I was consistent in my procedures during both observation and interviewing. That is not to say I asked the same questions in the same way in every interview. On the contrary, an interviewer cannot and indeed should not strive for sameness in each interview. The procedures and way in which interviews are conducted, however, should be consistent. For example, each interview was taped, was introduced similarly, and followed the same format of questioning.

Fieldwork, especially for limited periods, can lead to problems of validity. Were my observations reflective of typical behavior of teachers and students? The same concerns pertain to interviewing. To increase the validity of the data, I used interviewing and observation as checks on each other throughout the study. If I saw puzzling, unusual, or otherwise inconsistent behaviors during observation, I asked about them in the interview session. Likewise, I reassessed observation notes if interview responses seemed inconsistent with observation data. Occasionally during interviews, for instance, teachers would overstate or understate their computer skills. In those instances, I relied on observations to assess their abilities and routines more accurately. In addition, to more thoroughly understand particular observations or discussions, I employed the strategy of indefinite triangulation (Cicourel, 1975), whereby accounts from different respondents concerning the same event or episode were collected and compared. In these instances, I gathered reports from other teachers, students, and principals, if necessary, in hopes of obtaining further insight. Employing this technique during the analysis of the data, I also interviewed several computer specialists who worked for the central boards of education for the public and parochial systems. The collection of multiple accounts regarding certain issues or events generally enhanced my understanding of what actually occurred.

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Computers and Work in Elementary Schools

Melissa Evans-Andris
University of Louisville, Kentucky

Take a look at the use of computers in classrooms from the teacher's perspective. Explore the best (and worst) ways to use computers in the classroom. Evans-Andris gives you models of the three basic computer-use styles teachers adopt.

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- Shift responsibilities to computer coordinators
- Support your teachers' efforts to use computers creatively and constructively
- Guide your staff through the tricky changes that result from bringing in technology

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